ENCYCLOPÆDIA BRITANNICA

SEVENTH EDITION.

X

THE

ENCYCLOPÆDIA BRITANNICA

OR

DICTIONARY

OF

ARTS, SCIENCES, AND GENERAL LITERATURE.

SEVENTH EDITION,

WITH PRELIMINARY DISSERTATIONS ON THE HISTORY OF THE SCIENCES,

AND

OTHER EXTENSIVE IMPROVEMENTS AND ADDITIONS;

INCLUDING THE LATE SUPPLEMENT.

A GENERAL INDEX,

AND NUMEROUS ENGRAVINGS.

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ENCYCLOPÆDIA BRITANNICA.

NAVIGATION, INLAND.

General observations.

INLAND WATERS, suitable for navigation, form a medium of conveyance, upon which can be transported, at a very small expense, and with a smooth or easy motion, all sorts of articles; but it is especially adapted for those which are very heavy, very bulky, or which could not well bear any rough carriage. In these respects, inland navigation has greatly the advantage of common roads, and is often preferable even to railways; and, besides, in many cases where a ship cannot be brought close up to a railway, goods can be loaded immediately from, or disloaded into, a canal-boat coming alongside of the ship, thus avoiding a second loading and disloading. Frequently, too, canals combine the advantage of aqueducts and of drainage with navigation; but they can never compete with railways where great speed of travelling is required, or where water is scarce, or in the time of frost; for the value of inland navigation in any particular country, or the fitness of that country for it, must depend very much on the supply of water, and the duration of the season which is exempt from frost. In the following brief treatise, we shall confine ourselves chiefly to artificial navigation,[1] and touch very slightly upon rivers and lakes; because descriptions of the most of these will be found in other parts of the work, either under their own names or those of the countries to which they belong; and the same thing may be said of various canals.

Origin of canals.

It is not known when, by whom, or in what country, artificial water communications were first constructed; though it is extremely probable that canals which had originally been made as aqueducts for drainage and for irrigation, came at length to be applied to the purposes of navigation. It is well known that works of this kind, connected with the Nile, the only river of Egypt, had existed in that country at a period so remote, that history has left us nearly as ignorant of the precise era of their origin, as it has of that of the pyramids. Nay, history does not so much as inform us with certainty when, or by whom, the great canal was first constructed, which anciently connected the Nile with the Red Sea. The early inhabitants of Babylonia or Chaldæa guarded against the detrimental inundations of the Tigris and Euphrates, by numerous artificial rivers and canals, which served to distribute the waters for the benefit of the country in general; and these at length were applied to form an easy navigation between its different parts. At a very remote period of antiquity, too, canals and pits were dug in Bœotia for drawing off the water of the Lake Copais, in order to prevent its overflowing the whole country; and these came to be afterwards used for navigation. The "*fossiones Philistinæ*," which were large canals, first made to drain the marshes bordering on the Po, are ascribed to the Canaanites, and especially to the Caphtorim, who at a remote period are supposed to have emigrated from the country of the Philistines.

EGYPT.

Great canal anciently constructed across the Delta.

It is not our intention to enter into a particular description of even the existing canals of Egypt; but, on account of the recent attempts to abridge the route to India by passing through Egypt, we shall briefly advert to the ancient history of its great canal, and to the proposals for restoring it, or constructing another across the isthmus of Suez, especially as the other route to India by the Euphrates has been abandoned. Some learned moderns, perplexed by the vague and contradictory statements of the ancients respecting a canal between the Nile and the Red Sea, have questioned its having ever existed, except partially as an aqueduct for irrigation. The survey made by order of Bonaparte in 1799 has, however, not only tended to remove these doubts, but also to ascertain the line which it

[1] In hereafter specifying the dimensions of a canal, we shall always have in view those which were given it artificially; for whenever the sides of a canal consist of ordinary earth, the marginal or protuberant corners gradually crumble away, taking a rounded form, whilst the hollow corners at the bottom are as gradually filled up, thus leaving the contour of the section of the canal for the most part curvilinear, and the water, of course, deepest in the middle.

Navigation, Inland.

followed. Of ninety miles of inland water communication of which it consisted, it appears that sixty-five were cut by human labour; and, of this portion, about one half yet exists in many parts so entire that its dimensions can be measured with tolerable accuracy, and little more than cleaning would be required to render it again fit for navigation. According to the French engineers, this canal extended upon one level from Bubastis to Arsinöe; or rather, it must have had a very slight declivity, so as to carry the waters of the Nile to the Red Sea.

The direct distance from the nearest point of the Mediterranean, which is a little south-east of Tyneh, to the northern extremity of the Arabian Gulf, which is a little to the north-east of Suez, is about seventy-five miles; and it is almost precisely the same from the latter to the site of the ancient Bubastis, on the now deserted Pelusiac branch of the Nile. The length of a canal from sea to sea, following what the French engineers considered as the most suitable ground, would be ninety-three miles, and that of the ancient canal from the Red Sea to the Nile was about ninety-two.

Since, according to the levels taken by the French, the inundation of the Nile, when not restrained by artificial barriers, must have reached to within two or three miles of the Red Sea, it has been supposed that the practicability of forming a canal must have suggested itself at an early period. The sandy isthmus north of Suez, which is but a yard above high-water level at present, has, no doubt, during the lapse of 3000 years, been raised a little by deposits of soil and sand. It is therefore supposed, that in those remote ages when the canal was first thought of, a shallow trench or furrow two or three miles long would have united the waters of the Nile and the Red Sea, affording the ancients a pretty correct idea of the relative levels of the Delta and the Gulf.[1] Aristotle, Pliny, and Strabo, ascribe the plan of forming the canal to Sesostris. The two former say it was abandoned because the waters of the Red Sea were higher than the Delta. Strabo treats this opinion as unfounded. Herodotus, in his book *Euterpe*, says the project was begun about 616 before Christ, by Necos, the son of Psammeticus, but who desisted at the command of the oracle, after having lost 120,000 men, and that it was completed by Darius Hystaspes; that the canal was supplied with water from the Nile, which it joined a little above Bubastis; and that it terminated in the Arabian Gulf near the city Patumos. Diodorus says it was begun by Necos, and continued by Darius, who afterwards abandoned it from the fear of Egypt being inundated by the Red Sea, but that it was completed by Ptolemy Philadelphus; that it extended from the Gulf to the Bay of Pelusium; and that it had sluices or gates, which were opened to allow ships to pass and quickly shut again (lib. i. sect. 1). According to Strabo, certain lakes above Pelusium in the desert were connected with the Red Sea by one canal, and with the Delta by another; and these lakes, which had originally been bitter, became sweetened by the introduction of the water of the Nile. This canal was completed by Ptolemy, who constructed a gate which afforded an easy passage between the sea and the canal, and which some fancy to have been what we now call a lock (lib. xvii.). According to Pliny, the canal reached only from the Nile to the Bitter Lakes, and was about thirty-four miles long. These statements may be reconciled by supposing, that though from the Delta to the Gulf the canal had been repeatedly opened, the communication with the Red Sea being difficult, and only available for ships during a very limited part of the year, this southern portion of the canal had been often closed and abandoned. The other portion being serviceable for a longer season, might be kept more generally open. About the year 644, the canal was re-established and greatly improved by the Caliph Omar, who carried the western end south to Cairo, by a branch called the "Canal of the Prince of the Faithful," but afterwards the "Canal of Cairo." The water being thus taken from a point of the Nile six feet higher than the former one, the navigation could, of course, be kept open during a much longer part of the year. In this way the Nile and Red Sea were connected for more than 120 years; but since then the communication has been shut during more than 1000 years.

Track of the canal from the Nile to the Red Sea.

The line or track of the ancient canal, in its more improved state, is generally represented on maps as having a pretty close resemblance to a semicircle, both extremities being nearly in the thirtieth parallel of latitude, and the middle about half a degree more to the north. Such a line almost coincides with that surveyed by the French engineers between Suez and Cairo, and which they have described in their great work on Egypt. But, from the flatness of the country, they thought it would likewise be quite practicable to construct a ship canal, which would join the two seas, independently altogether of the Nile, by leading off a branch from near the middle of the line which we have just mentioned, to meet the Mediterranean at Tyneh, a place nearly in the meridian of Suez. This second canal being only of the same length as the other, and free from the tedious navigation of the Nile, would be a much shorter route; and, if fed and kept clear by a constant current from the Red Sea, it would be navigable at all seasons, and quite independent of the extremely variable depth of water in the Nile. According to the French engineers, the current having a fall of twenty-six feet, would have energy enough not only to clear the canal of drift sand, &c. but also to hollow out and maintain a channel in the shallow and muddy bottom of the bay at Tyneh, so as to afford a sufficient depth of water into the port. Some English engineers, again, who have more recently visited Egypt, think a preferable and still shorter canal might be constructed from Suez to the great lake Menzaleh, which communicates with the Mediterranean to the west of Tyneh. But there is every reason to believe that the proposed railway across the isthmus would be greatly preferable to any canal which would not admit ships.

There would be no tunnels, nor rock cuttings, nor stupendous aqueduct bridges required in forming a ship canal across the isthmus. The only difficulty would probably be to obtain a sufficient depth of water at the ports in the two seas. Were this attained, we might assert with Mr Maclaren, "that there is not a spot in the world where a water communication of equal extent could be made with the same facility, and where human skill could produce so great a change with so small an effort." The navigation would suffer no interruption from frost in that climate; though there is reason to think that the difference of level in the two seas must vary somewhat with the direction and force of the wind, increasing with a south wind, and diminishing with a north; but this is not likely to be to such an extent as to prove at all detrimental to the scheme.

Present navigation of Egypt.

The Nile, which is remarkable for having no tributaries for 1300 miles up from its mouth, continues navigable for large vessels 600 miles above Cairo, up to the cataracts,

[1] Such is nearly Mr Maclaren's view of the matter (Edin. Phil. Jour. vol. xiii. p. 274); but, since the levels of several coasts, relatively to those of the contiguous seas, are known to have varied sensibly in the course of a few centuries, it is evident that, independently either of depositions or corrosions, the relative levels of the Delta, Mediterranean, and Red Sea may now be very different from what they were 3000 years ago. Hence such a mode of judging how far the notions of the ancients on this point were correct, entirely fails.

Navigation, Inland.

so long as it is sufficiently swollen by any remains of the inundation; but its waters become so low in May and June as only to be then navigable for small boats. A great part of the Delta is intersected in all directions with canals or aqueducts conveying water from the Nile for the use of the inhabitants, and for irrigating their fields; and some of these are likewise used for navigation. The present enterprising ruler of Egypt has turned his attention to the construction of canals; but, like his predecessors of old, he has been much blamed for being a very hard task-master, especially to the poor women and children, whom he compels to assist the men in digging canals, with no other tools than their fingers, and to continue at such work sometimes till numbers of them expire upon the spot. The "house of bondage" was nothing to this. The pasha has, however, been very unfortunate in the canal which he made in this manner, with the loss of 23,000 lives in ten months, from Alexandria to Fouah, a distance of about forty miles, as it has by no means come up to his expectations.[1] It is said that he is about to construct a very gigantic bridge of stone across the Nile, at the point where it is cleft into two principal branches, about five leagues below Cairo; and that this bridge is to be furnished with gates for regulating and retaining the waters for the necessary supply of the aqueducts and canals. Already he has made a bridge of this sort over the ancient Canal of Jussuf, which runs along the west side of the Nile, considerably above or to the south of the proposed new bridge.

CHINA.

Chinese canals.

No country abounds more in canals and navigable rivers than China; but the greater part of that vast empire is so little known to foreigners, that the state of its inland navigation is in a great measure conjectural. The Chinese date the formation of some of their canals prior even to the Christian era; but, however that may be, they have, as far as is known, made almost no improvement on their mode of construction since Europeans became acquainted with them. Their canals, after all, are rather rivers flowing through considerably altered channels, than what are strictly artificial communications by still water. The Imperial or Grand Canal, forming a communication between Canton and the neighbourhood of Pekin, is, according to some, 2000 miles long, whilst others make it only 825. The whole line is no doubt of great length, but it is uncertain how much of it is mere river navigation. It is said to have occupied 30,000 men for forty-three years, and to have been completed in A. D. 980. Innumerable branches run from it in every direction. Since almost no part of it is level or still water, it has been inferred that the Chinese are ignorant of levelling; but this we should regard as a most groundless surmise, because the mere dealing so much with the management of waters as they have done for many ages could not fail to have taught these people, however stupid, something of the principles of levelling. It seems rather to have been the want of locks which naturally led them purposely to give that form to their canals; and it should not be forgotten that stagnant canals would be exceedingly unwholesome in a warm climate.

INDIA.

The inland navigation of the vast territory of India is of the most extensive sort, particularly that of the great rivers, the Indus, the Ganges, and the Brahmaputra, with their numerous branches, creeks, and canals. Taking the limit of the Ganges and Jumna to the west and south, and the Brahmaputra and Megna to the east, the country intersected by navigable rivers, &c. may be computed as covering an area exceeding 180,000 square miles.

Indus.

There is an uninterrupted navigation of 1000 miles up the Indus from the sea to Lahore, which is situated on the Ravee or Hydraotes, one of the most meandering of the five Punjab rivers or branches composing the Chenab. But, owing to the numerous shallows and sand-banks in some parts of the Indus, this extensive navigation can only be said to be open to the flat-bottomed boats of the country, which draw but four feet of water. There are, however, few rivers on which steam could be used with better effect than on the Indus, which is said to discharge four or five times as much water as the Ganges. It has no rocks nor rapids, and, unless when swollen, the current does not exceed two and a half miles an hour. The swell commences about the end of April, increases till July, and disappears altogether in September. Captain Burnes, who treats largely on this subject, supposes that the Indus is also navigable all the way up to Attock.[2]

There are many canals connected with the Indus, but they are principally for the purpose of irrigation, and the greater part of them are mostly natural creeks, having no water except during the swollen state of the river. Such canals intersect the delta, and are likewise pretty numerous between the latitudes of 26° 20′ and 28°, particularly on the west side of the river; but the most ancient artificial canals connected with this river seem to belong to the Punjab district.

Ganges.

By means of the Ganges and its subsidiary streams, all sorts of articles can be conveyed between the sea and the north-west portions of Hindustan, over a distance of more than 1000 miles; and the time may not be distant when the navigations of the Indus and Ganges will be connected by a canal. The commercial capital Calcutta, upon the Hooghly branch of the Ganges, is therefore favourably situated for internal navigation. It is about 100 miles from the sea, and 130 from the Sandheads; but it has a very intricate and tedious navigation through the banks of sand and mud, which occasionally shift their beds in the Hooghly River, as well as in the other branches of the Ganges. The Nuddeah Rivers, which connect the Ganges with the Hooghly, are likewise, for eight months in the year, so extremely shallow, that the water communication between Calcutta and the upper country is during that time maintained by the Sunderbund passages, at a great expense of time and labour. To obviate this inconvenience, it has been proposed to construct a canal, which, branching off from the Ganges at Rajamahl, shall join the Hooghly at Mirzapore near Kulna; for, owing to the difference of level at the extremities, amounting to sixty feet, and the height of the Ganges itself varying thirty feet at different seasons, an open cut, without locks, would not suffice. The intended line, besides, being 300 miles shorter than the present route, would traverse a country rich in iron-ore and limestone, and would pass near extensive collieries.

Since the renewal of the East India Company's charter, the following works have been executed: Canal between the Ganges and Bugruttee Rivers; repair of an ancient aqueduct in the Deyra Doon, and restoration of the Delhi Canal; canal to unite the Hooghly with the Ganges, through the Salt-water Lake; canal to unite the Damrah and Churramunee; re-opening of Feroze Shah's Canal in Delhi completed; restoration of Zabita Khan's Canal in the Upper Dooab; the course of Ali Murdher's Canal drawn into Delhi; a new cut for the Votary Nullah; and canal at Chumnapore. A canal of seventy miles is now being exe-

[1] St John's Travels in the Valley of the Nile.

[2] Captain Burnes' Travels to Bokhara; and his Memoir on the Indus, in the Journal of the Royal Geographical Society.

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cuted, if not already finished, in the king of Oude's dominions, between the Ganges and its tributary the Goomty. There are several canals in Agra, but they are chiefly used for irrigation; some of them are of considerable antiquity.

Backwater navigation.

South Malabar, and nearly all Travancore, are naturally provided near their coasts with a noble system of inland navigation, called the Backwater, which extends from Chowghaut in Malabar on the north, to Trivanderam, the capital of Travancore, within fifty miles of Cape Comorin, on the south, a distance of 170 or 180 miles. A continuation of it is in progress of being naturally formed, and is in fact navigable ninety miles farther for small boats during the rains, from Clowghaut to Cotah, sixteen miles south of Tellicherry; and all that this portion requires is, that the bed be deepened during the dry weather. The rivers descending to the sea at intervals of every eight or ten miles, would flow into and fill the deepened bed during the rains. The Backwater runs nearly parallel to the seashore, sometimes at the distance of a few hundred yards, at other times of three or four miles. Its breadth varies from 200 yards to twelve or fourteen miles; its depth from many fathoms to a few feet. Into this Backwater, as into a grand trunk, all the numerous rivers, flowing like so many veins from the Western Ghauts, are discharged and retained. The Backwater empties itself into the sea only by six mouths; of all which the only one navigable for ships is the mouth on the south bank of which is situated Cochin. There is a bar at this mouth, but on it there are seventeen or eighteen feet of water at spring tides.

CEYLON.

In the maritime provinces of Ceylon, particularly in Batticaloa, the internal communication is maintained by canals connecting extensive salt lakes, which have stupendous embankments, said to have been constructed by the Cingalese three centuries before the Christian era. Small vessels from India may land their cargoes at Calpentyn, in the Gulf of Manaar, and have them conveyed by canal to Columbo. In the southern parts, where the rains are copious, canals are not less useful in draining the low lands than in the conveyance of produce; whilst in the northern districts, owing to the frequent droughts, they are in the greatest request for irrigation. There are rivers in Ceylon which might be rendered navigable to a considerable extent. Mr Brook, in tracing the course of the Maha Villagunga River in 1825, came on the ruined tracks of several very extensive canals, one of which had been from five to fifteen feet deep, and from forty to 100 feet wide, and which, according to the natives, had been cut by people forty feet in height.

EUROPE.

Both Greeks and Romans failed in their repeated attempts to cut a canal through the Isthmus of Corinth. The Romans indeed were more successful in some of the branches which they cut for drainage from the Rhine; though these and others of the sort are now likely soon to be all cut off, or closed next the Rhine by locks. But the honour of properly introducing artificial navigation into Europe seems to be due to Italy and Holland, in both of which countries it has long been practised to a considerable extent, though their canals were made principally for the purposes of irrigation and of drainage. It is now computed that about the twenty-sixth part of Holland is taken up by canals, one of which is of uncommon dimensions. They have been gradually introduced into the different countries of Europe, and to such an extent that, by means of canals and rivers, an internal water communication now connects various parts of the great seas which surround that quarter of the globe.

Navigation, Inland.

The Caspian is connected with the Baltic through the Wolga, the great lake Ladoga, and intervening canals; and the Baltic is also connected with the Black Sea through other rivers and artificial waters.

The Ladoga Canal, formed along the southern shore of that lake, for the sake of a better navigation, extends from Schlusselburg to New Ladegaat, at the mouth of the Volkof, a distance of sixty-seven miles and a half, on one level, with a guard-lock at each end. This canal is seventy feet wide; and the depth of water, according to the season of the year, varies from seven to ten feet. To such an extent has inland navigation been carried in Russia, by connecting rivers and lakes by canals, that, with the exception of one interruption or portage of sixty miles, goods may be conveyed by water 4472 miles, from Petersburg to the frontiers of China; and also from the same capital to Astracan, a distance of 1434 miles.

The Bega Navigation, in Hungary, extends about seventy-three miles, from Fascet through the Bannat by Temeswar to Becskerek, whence vessels pass by the Bega into the Theiss, a little above its junction with the Danube. The Canal of Francis, again, extends from the Danube by Zambor to the Theiss, which it joins near Földvar, being sixty-two miles in length. The summit rises only twenty-seven feet.

On the west, the German Sea communicates with the Baltic likewise by the Canal of Kiel through Holstein, and by the Gotha Navigation through Sweden. The famous Canal of Languedoc, in the south of France, forms a communication between the Mediterranean and the Atlantic; and the equally famous and more capacious Caledonian Canal, in the north of Scotland, forms a similar communication between the German and the Irish Seas. Most of the great rivers and many lakes in other parts of Europe are also connected by canals, thereby greatly facilitating the intercourse between different nations, as well as between different parts of the same state. In the north of Germany, the Elbe,[1] the Oder, the Vistula, and the Niemen, are so connected by canals as to form a water communication over an extent of about 500 miles, viz. from the frontiers of Russia to the city of Hamburg, and running nearly parallel to the shores of the Baltic, at a distance of 100 miles. This is often called the Prussian Navigation.

The Canal of Kiel joins the river Eyder with the bay of Kiel, on the north-eastern coast of Holstein; thus forming a navigable communication between the German Sea and the Baltic, and enabling vessels to pass from the one to the other, without performing the long and difficult voyage round Jutland, and through the Cattegat and the Sound. The Eyder is navigable for vessels not drawing more than nine feet water, from Tonningen, near its mouth, to Rendsburg, where it is joined by this canal, which communicates with the Baltic at Holtenau, about three miles north of Kiel. The length of the canal is about twenty miles and a half, exclusive of about six miles and a half of what is principally river navigation, but attended with considerable difficulty, from shifting sand-banks. The canal is about ninety-five feet wide at top, fifty-one and a half at bottom, and nine and a half deep. Its summit rises twenty-four feet and a third above the sea, by six locks.

The Gotha Navigation in like manner connects the Cattegat at Gottenburg with the Baltic at Soderkœping. It

[1] According to Berghaus, the waters of the Elbe will not be navigable twenty-four years hence, if they continue to diminish at the same rate as they have done for the last fifty years; but attempts are being made to deepen it by dredging. Many other inland waters are said to be on the decrease, particularly the Caspian.

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consists partly of canals and partly of the river Gotha and the lakes Wener, Wetter, &c. The late Sir Thomas Telford visited and was consulted in several parts of this work, which is said to be a masterly performance. The navigations, however, in the northern and interior parts of Europe are sadly interrupted by frost during a great part of the year, and therefore merit less notice.

Holland.

Canal of Amsterdam and Niewdiep.

The canals of Holland are innumerable; but, on account of the smallness of that country, and our narrow limits, we shall only notice the great ship canal of Amsterdam and Niewdiep, which is one of the most magnificent and capacious in the world. It was constructed to afford a safe and easy passage for large vessels between Amsterdam and the German Sea; for although the roadstead in front of this city has forty feet of water, yet, on the pampus or bar, where the river Ye enters the Zuyder Zee, there are only ten feet; and therefore any considerable ship must only be partially loaded when passing this bar. The Zuyder Zee being everywhere full of shallows, all ordinary means of improving the access to Amsterdam necessarily failed; and this seems to have suggested the idea of constructing a great ship canal from this city to Niewdiep, near the Helder, the most northern point of the province of Holland. The direct distance is forty-one miles, but along the track of the canal it is about fifty and a half. The width at the water's surface is a hundred and twenty-four feet and a half, at the bottom fifty-six, with a depth of twenty feet nine inches. Like most of the Dutch canals, its level is that of the highest tides, and it receives its supply of water from the sea, but which at neap tides has to be raised by a steam-engine. The design of the high level is no doubt to exclude mud. This canal is crossed by about eighteen drawbridges. It has tide-locks only, and these are, of course, at the extremities; but between them there are, besides, two sluices with flood-gates. The locks and sluices are double, that is, there are two in the breadth of the canal. There is a towing path on each side, and the water is broad enough for two frigates to pass. This canal was begun in 1819, and finished in 1825. From the Ye at Amsterdam, where the canal begins, between artificial embankments, it proceeds north to Purmerend, then west to Alkmaar Lake, again north by Alkmaar to within two miles of the sea near Petten, from which it runs nearly parallel to the coast till it joins the sea at the fine harbour of Niewdiep. The Helder is the only place on the shores of Holland which has deep water, and this is owing to its being opposite the Isle of Texel, which, by contracting the water to about the breadth of a mile, occasions a current sufficient to scour and deepen the channel. Had it not been for the shallow water, a canal of half the length might have connected Amsterdam with the German Sea.

France.

By means of its fine rivers, France was naturally possessed of a considerable inland navigation; but it has, besides, many excellent canals, and in various places this extensive country is well adapted for a great many more. We can, however, only give a brief description of its principal canals, some of which are of very recent construction, or not quite finished.

Languedoc Canal.

Languedoc Canal, connecting the Bay of Biscay with the Mediterranean, commences in the port of Cette in the bay of Lyons, from which it proceeds in a westerly direction through the lake of Thau, passing by Agde, Beziers, and, through a tunnel of 181 yards at Malpas, thence by Sommail to Carcassonne. From this the course is north-west by Castelnaudary to Naurouse, which is on the summit-level; and to this it has ascended in all $621\frac{1}{2}$ feet, by seventy-four locks. The remainder of the track continues north-west to its termination in the river Garonne at Toulouse, with a total descent of 207 feet by twenty-six locks. The entire length is 241,146 metres, or about 148 miles; breadth at top sixty-one feet, at bottom thirty-four, with a depth of six feet and a half. The total length of feeders is about forty-nine miles.

This great canal was begun in April 1661, and finished in June 1681. The rest of its history is given at great length in most works on inland navigation. But although usually ascribed to the genius and skill of Paul Riquetti, intendant of the province of Languedoc, it is very questionable how far he was qualified for such a vast and difficult enterprise, in which he had had no previous experience. Nay, from a comparison of the different statements, it appears that, in place of engineer, Riquetti had been rather the contractor for the whole works, and had advanced one fourth of the outlay, for which his descendants still draw a considerable revenue from the canal. According to General Andreossy,[1] the works were planned and conducted by a relative of his, François Andreossy, an Italian engineer, who had had experience in the construction of canals in his own country, and who was employed by Riquetti to conduct this great work.

The Canal of Narbonne is a branch running south from the Canal of Languedoc to Narbonne, where, uniting with the Robine, the line is continued to the sea considerably to the south-west of Cette. Narbonne.

The Canal of Arles and Bouc was undertaken in order to avoid the shifting sands which render the navigation of the mouths of the Rhone difficult and dangerous. Besides, it affords an outlet to the superfluous water of the district, by which means lands formerly useless may be rendered valuable. This canal extends twenty-seven miles and a half along the east bank of the Rhone, from Arles on that river to the port of Bouc in the Mediterranean. It is furnished with four locks. Being intended for sea-going vessels, it is sixty-eight feet wide at the top, forty-four at bottom, and fully six feet deep. The sides are raised three feet above the highest floods of the Rhone. Arles and Bouc.

The Canal of Beaucaire is very similar to that of Arles and Bouc, was made for a similar purpose, and is nearly of the same length, with four locks. It commences at Beaucaire, on the west bank of the Rhone, and extends in a south-west direction by Aigues Mortes to the sea; but from Aigues Mortes it also communicates with Montpellier and the port of Cette by means of the Canal de Grave and the Canal of the Lakes. Beaucaire.

The Canal of Craponne commences near Arles, and runs eastwards for about thirty-five miles to the Durance. It is principally used for drainage. Several others, which branch southward from it, are chiefly employed for the same purpose, and for irrigation. Craponne.

The Canal of Givors commences at that place, on the Rhone, ten miles below Lyons, and proceeds eight miles to the Gier. It was originally intended to have been continued to the Loire at St Etienne. Givors.

The Canal of the Centre commences in the Saone at Chalons, and terminates in the Loire at Digoin, from which the navigation is continued by the Canal of the Loire. It is about seventy-one miles long, rising 400 feet from the Saone by fifty locks, and falling 240 feet to the Loire by thirty locks. Centre.

The Canal of the Loire begins at Digoin, in the Canal of the Centre, from which it crosses the Loire by an aque- The Loire

[1] *Histoire du Canal du Midi*, 8vo, Paris, 1800.

duct of five miles, and running along the south-west side of that river, it also crosses the river Allier by an aqueduct, but still continuing on the same side of the Loire, till, a little above Briare, it re-crosses that river through its bed, and there terminates in the Canal of Briare. Its whole length is 134 miles, with forty-five locks for a rise and fall of 317 feet. It was begun in 1822, and was nearly finished at the end of 1836.

Briare. The Canal of Briare, connecting the Seine with the Loire, was the earliest important project of the sort in France, and the first in that country which had locks carrying it over a height. It was begun in 1605, and finished in 1642; but the works had been suspended from 1610 to 1639. The length is thirty-four miles and a quarter, but the breadth varies from twenty-five to thirty-two feet. It begins in the Loire near Briare, ascends by Ouzonne along the side of the Trezée River, by Rogny, where there are seven locks; then passes by Chatillon and Montargis, and near Cepay joins the river Loing, a tributary of the Seine.

Loing. The Canal of Loing is a prolongation, for about thirty-three miles, of the Canal of Briare, from Montargis to the Seine, near the city of Moret. It descends 137 feet by twenty-one locks.

Orleans. The Canal of Orleans connects the Canal of Loing near Montargis with the Loire near Orleans. The length is about forty-five miles, with twenty-eight locks for a rise of 137½ feet from the Loing, and a fall of ninety-eight to the Loire.

Nivernais. The Canal of Nivernais begins in the Yonne at Auxerre, and ends at Decize, near the junction of the Aron with the Loire. It is 103 miles long, with 117 locks for a rise and fall of 746 feet. It is only partially in use, but is expected to be finished in 1838.

Berry. The Canal of Berry, or of the Cher, consists of three branches united at one point near Khimbé. Their total length is 186 miles, with 110 locks for a rise and fall of 757 feet. The works are unfinished, and the navigation only partially in use.

Layon. The Canal of Layon consists of the river Layon made navigable for thirty-five miles up from its mouth at Chalonne on the Loire. It has twenty-eight locks, and is principally used for the carriage of coals.

Nantes and Brest. The canal from Nantes to Brest was intended principally for conveying materials and stores during war to the largest and most important arsenal of France. It is composed of three canals passing successively from the basins of the Loire, of La Vilaine, and of Blavet, to the river Alne, which joins the harbour of Brest. Its total length is 218 miles, with 238 locks for a rise and fall of 1711 feet; but there are about seventy miles not yet finished.

Blavet. The Canal of Blavet, which is only a branch, towards the sea, of the Nantes and Brest Canal, begins at Pontivy and ends at Hennebon. Its length is thirty-four and a half miles, with twenty-seven locks for a rise and fall of 162 feet. From Hennebon the Blavet is navigable to the sea.

Ille and Rance. The Canal of Ille and Rance is designed to open a navigable communication between the Channel and the Bay of Biscay, across the peninsula of Bretagne; and also to connect, through the Canal of Nantes and Brest, the ports of Nantes, Brest, and St Malos. It is fifty miles long, with twenty locks for an ascent of 129 feet on the side of the Vilaine, and twenty-eight locks for 193 feet on the side of the Rance. This canal was begun in 1804 and opened in 1832, but the reservoirs are scarcely yet completed.

River Isle. In the course of the river Isle, between Perigueux and Libourne, which is eighty-four miles and a half, the difference of level is 237 feet. It was therefore naturally unfit for navigation. To remedy this, it has lately been furnished with thirty-nine locks, and various other improvements have been made on the channel to render it navigable.

Rhone and Rhine. The Canal of the Rhone and Rhine connects the basins of these two rivers, commencing on the Saone near St Jean de Losne, and ending near Strasburg. It is sometimes called the Canal of Alsace. The entire length is 203 miles, including the branch of sixteen miles and one third from Mulhausen to Huningue, near Basle. The principal line has 160 locks, and the branch four: there are also thirteen sluices. There is a rise of 550 feet on the side of the Saone, and a fall again of 658 on that of the Rhine. This canal was planned about the middle of last century; the part between the Dôle and the Saone was begun in 1784 and finished in 1790; but the whole line was only opened in 1834.

Burgundy. The Canal of Burgundy, uniting the basins of the Seine and of the Rhone, and thus forming part of perhaps the shortest navigable line from Havre de Grace to Marseilles, has one end at La Roche-sur-Yonne, and the other at St Jean de Losne, on the Saone. Its entire length is 141 miles, with 191 locks; it rises 612 feet from the Saone, and falls again 923 feet towards the Yonne. It has a tunnel of two miles. It was begun in 1775, and, after various interruptions, opened in 1832. There has been a deficiency of water in the dry season, but possibly this may be remedied.

Ardennes. The Canal of Ardennes, connecting the valleys of the Aisne and the Meuse, begins at Doncherry, on the Meuse, and joins the Aisne at Semuy, whence it is continued on the one side to Neufchâtel, and on the other to Vouziers. It has forty-nine locks to overcome a difference of level of fifty-two and a half feet next the Meuse, and 355½ towards the Aisne. The total length is sixty-one miles.

Ourcq. The Canal of the Ourcq is only the river of that name rendered navigable for twenty miles, principally to supply Paris with water, and to turn mills.

Seine to the Seine. The canal from the Seine to the Seine, viz. from near St Denis to the basin of the arsenal, near the Pont du Jardin du Roi, is about eight miles long, and was made to avoid the bridges of Paris, and a loop or bend of the river amounting to about seventeen miles. It consists of three parts: 1st, The Canal of St Denis, which is four miles and a quarter long, with twelve locks; 2d, about one mile of the Canal de l'Ourcq; and, 3d, the Canal of St Martin, which, including the basin of the arsenal, is about two miles and three quarters.

St Maur. The Canal of St Maur is a cut of three quarters of a mile, to avoid a bend of eight miles in the Marne, about two miles and a half above its junction with the Seine. It has often been proposed to cut off other bends in these rivers. Several of the long narrow loops in the Seine, near Rouen, might be easily cut off with great advantage; but the river is in general so ill suited for navigation on other accounts, that a separate canal, as has long been proposed, would be greatly preferable.

River Oise. The river Oise forms the channel through which the canals of the north, as well as the Scheldt, the Somme, the Meuse, and the Aisne, communicate with Paris. The importance of keeping it in a proper state for trading vessels is therefore sufficiently obvious. A lateral canal of seventeen miles was opened in 1828. It connects two points on the river twenty-eight miles distant along the course, and avoids a difficult and dangerous navigation to that extent. The towing and pilotage of a large boat, which now cost only four or five francs, along the canal, formerly cost 200 along the part of the river for which the canal is substituted. The traffic has of course increased remarkably.

The Somme. The Canal of the Somme, which is part of a navigable line connecting Paris with the sea, is ninety-one and a half miles long from its commencement, near St Limon, to its termination at the mouth of the Somme. It has twenty-three locks, with a rise and fall of 178 feet.

Navigation, Inland.

St Quintin.

The Canal of St Quintin commences at that place on the river Somme, and proceeds by Omini, Le Trouquoi, Bellinglise, Riqueval, and Maquincourt, to Cambray on the Scheldt, a total distance of thirty-two miles and two thirds. From the commencement to the lock of Trouquoi, at the end of the summit, is about four miles, rising thirty-three feet and a half by five locks. The summit-level extends about thirteen miles and a quarter. In this there are two tunnels; one of 1191 yards at Trouquoi, and another of the very great length of three miles and three-fifths at Riqueval. Their width is twenty-six feet and a quarter. The remaining fifteen miles and two fifths to Cambray descend $123\frac{1}{2}$ feet by seventeen locks. From this the navigation may either be continued along the Scheldt, or by the Canal of Lille or that of St Omer, the river Deule, &c. to the sea at Calais, Gravelines, Dunkirk, Furnes, Ostend, &c.

Spain.

Spain, from its abounding in great valleys separated by rugged mountains, is not the most suitable country for inland navigation. But its principal rivers, the Ebro, Guadalquivir, Guadiana, Tagus, Douro, and Minho, are to a considerable extent navigable, have their sources in the middle of the kingdom, and fall into the Atlantic Ocean and Mediterranean. These, and various other rivers of less note in Spain, might easily be connected by navigable canals, so as to form a ready communication between many of the interior districts of that extensive country, and between these again and the sea. In this, as in many other respects, the prosperity of Spain has been greatly impeded by superstition, priestcraft, changes of dynasties, and the frequent wars in which it has been involved, so that it has accomplished very little indeed in inland navigation. An early project of the sort was, however, effected by the Saracens, who formed a canal from the city of Grenada to the navigable river Guadalquivir, which falls into the Bay of Cadiz. But the Romans, it is said, had long before this formed an aqueduct to convey fresh water to Cadiz, from springs more than thirty miles distant.

In 1776 a canal was projected, and partly executed, to form a communication between Carthagena and the river Gualantin, at a distance of more than 100 miles. In 1784, a survey was made of a canal, which, beginning near the Escurial, should proceed to join the Tagus, thence to the Guadiana, and terminate in the Guadalquivir, above Andujar. It was partly executed. It is chiefly in the north of Spain that canals have been constructed. A line projected in Old Castille, from Segovia to Olea, near Reynosa, is ninety-nine miles long, exclusive of the principal branch to the cities of Castille and Leon. Another canal has been projected in the province of Campos, to the west of Pisuerga, to pass by Medina de Rio Seco, and at Grisotu to unite with the Canal of Castille. The Emperor Charles V. of Germany proposed a canal to be carried along the valley of the Ebro, and onward to the Bay of Biscay. It was intended to receive the waters of the Ebro at Tudela, in Navarre, and thence descend towards Saragossa and Quinto.

Great Britain.

General observations.

Long after artificial canals had been introduced on the Continent, England contented herself with merely endeavouring to improve the navigation of her rivers. The principles on which the earliest acts of parliament were framed for this purpose, consisted in deepening, straightening, and embanking the rivers, where necessary; and, by means of sluices and weirs, penning up or lowering the surface of the water, for the purpose of producing "flashes," and overcoming the obstructions to navigation. Long experience, however, showed that navigations of this sort were liable to perpetual deterioration, from the alterations produced in the regimen of the rivers by such artificial works, which frequently augmented instead of remedying the evil, whilst they obstructed the general drainage of the country. The circuitous navigation, and the trackage against the stream, were at all times laborious and dilatory. These difficulties suggested the propriety of deserting the natural bed of the river, and led to the formation of separate cuts, with the pound-locks, and the various contrivances which were subsequently invented to supersede their use. Until the invention of the lock, therefore, very little could be done in the way of inland navigation, except in the fens, when connected with drainage. Accordingly, the most ancient attempts of this kind are to be found in the Carr and Foss Dikes by the Romans; the former skirting the uplands and fens, from the river Nene at Peterborough, to the river Witham, near Lincoln, by a canal of forty miles; and the latter connecting the Witham at Lincoln with the Trent above Gainsborough, by a level cut of eleven miles.

Navigation, Inland.

In England, the artificial system of navigation has been carried on for more than half a century, on a scale no less extensive than the drainage. The passing of an act in 1755 for constructing the first artificial canal in England, which was that of Sankey Brook, the completion of that work in 1760, and the formation of the Duke of Bridgewater's Canal in 1761, opened the eyes of the nation to the vast advantages that were likely to be derived from artificial navigation, and led to the system of direct and indirect communication, which has united all the great rivers and ports of the kingdom. In Scotland, the progress of inland navigation, although less rapid, has been proportionally successful. As early as the reign of Charles II., the idea of joining the Forth and Clyde is said to have originated with his brother, James Duke of York; and, if true, forms a singular exception to the rest of his history. The subject was again resumed in 1722; in 1760 a survey was made by Messrs Mackell and Watt; and in 1766 that great work was commenced by Mr Smeaton, and completed in 1790. Between the above periods, also, Mr Watt made many reports on the improvement of the Clyde, and on the proposed Monkland, Crinan, and Caledonian Canals; and, in 1802, Mr Telford was employed to make surveys of the whole coast and interior of Scotland, with a view to improving its harbours and rivers, and which ultimately led to the execution of the Caledonian Canal by that able engineer.

The following is a concise account of the principal inland navigations of Britain, arranged alphabetically.

Aberdare Canal, about six and a half miles long, is a branch of the Cardiff or Glamorgan Canal, from near the aqueduct of the latter over the river Taff. It terminates at Ynys Cynon, three quarters of a mile from Aberdare. From this canal proceed railways to the iron-works of Godleys, Abernaut, Aberdare, &c. and also to a steep descent to the Neath Canal, up which waggons are drawn by a steam-engine. It has been proposed to unite the Aberdare Canal with that of the Neath.

Aberdeen Canal extends about nineteen miles from the tideway in the port of that town up the valley of the river Don to Inverury. It rises 169 feet by seventeen locks, of which fifteen are near the city. The width of this canal is twenty-three feet, and the average depth three feet nine inches.

The Adur River, in Sussex, has been rendered navigable southward from Binesbridge, in West Grinsted, to the sea at Southwick, below Shoreham Harbour, a distance of fourteen miles.

Aire and Calder Navigation. The river Aire, in Yorkshire, is navigable for sloops of sixty tons for forty miles, from its mouth in the Ouse at Armin, up to Leeds, where the Leeds and Liverpool Canal begins. The river Calder falls into the Aire about ten miles below Leeds, and is navigable about ten miles to Wakefield, where the Calder and Hebble Navigation commences. From the Aire and Calder not less than three canals and their branches have been carried across the central ridge of England to Manchester and Liverpool, forming an important water communication between that port and Hull, and between these and the intervening manufacturing districts.

Alford Canal is to extend from the town of Alford, in Lincolnshire, to the sea at Anderby, a distance of six and a half miles, with a depth of eight feet.

The Ancholm and Caistor Navigations join the Humber above Hull. The old meandering course of the river Ancholm is changed into a nearly straight canal twenty-six miles long, and running nearly from south to north. The Caistor Canal, which meets it from the east, is about four miles long. They serve the double purpose of draining a marshy track, and affording a communication to the towns of Caistor and Market-Raisin.

Andover Canal begins in the tideway at Redbridge, in Southampton Water, and proceeding northward up the east side of the Anton River, ends at Barlows Mill, near Andover. It is about twenty-two miles and a half long, and descends 177 feet towards the sea. From near its middle the abandoned Salisbury Canal branches off to the west, whilst from its south end the Southampton Canal passes eastward to the Itchin River.

Arun River Navigation begins at Newbridge, near Wisborough Green, and proceeds thirteen miles, partly by the course of the river, and partly by cuts to Arundel Haven. From this the river Arun itself has been rendered navigable all the way to Arundel Port, making a total length of twenty-six miles and a quarter.

Arundel Canal, see Rother River.

Ashby-de-la-Zouch Canal passes by a very winding course northward for forty miles, to the town of that name, from the Coventry Canal at Marston Bridge, near Newneaton. The first thirty miles and a half, together with parts of the Oxford and Coventry Canals, form one level of seventy-three miles; but on the next two miles there is a rise of 140 feet to the summit-level, which then continues four miles north of the great tunnel, and in the next quarter of a mile the fall is eighty-four feet. One branch of about two miles goes off to Swadlingcote Colliery; another almost a mile falling twenty-eight feet to Stainton Lime-works; a third 200 yards to Hinckley Wharf. Besides, there is a railway of about six miles to Ticknall Lime-works, and another of five miles to Measham Collieries. Near Ashby-de-la-Zouch is a tunnel of 700 yards, and near Snareston another of 200 yards. At Boothorpe a steam-engine raises water, which passes in a feeder to the summit-level. This canal passes one aqueduct bridge at Shakerton, and another at Snareston.

Ashton and Oldham, or Ashton-under-Lyne, Canal, branches off from the Rochdale Canal at Manchester. It passes Fairfield, and terminates in the Huddersfield Canal at Duckenfield Bridge. The length is eleven miles, and the rise 152 feet. A branch of a quarter of a mile connects it with Peake Forest Canal, another of one mile goes up to the town of Ashton, a third of nearly four miles to New Mill and to Park Collieries, and a fourth of six miles to Stockport.

Avon River, Hampshire, was once made navigable from the sea at Christchurch north to Salisbury, a distance of 36 miles. The works were, however, very insufficient, and were allowed to go to ruin, and the river is now only navigable two miles in the tideway.

Avon River, Warwickshire and Worcestershire, is navigable from Stratford-upon-Avon, near the junction of the Stratford Canal, to the Severn at Tewkesbury, a distance of forty-three miles and three eighths, in a south-westerly direction. This navigation is of great use to the towns of Pershore, Evesham, and Stratford.

Avon River, Gloucestershire and Somersetshire, is navigable from Bath, near the commencement of the Kennet and Avon Canal, and passes by Bristol to the Severn at King's Road, a distance of twenty-six miles and a half in a north-west direction. Its course formerly lay through the heart of the city of Bristol; but a new channel for the river has been cut on the south side of that city, two miles in length, whilst the ancient course has been converted into an excellent floating dock and harbour, which on the north receives the small river Frome, navigable only for half a mile through the city. At Morgan's Pill, six miles below Bristol, is the junction of the proposed Bridgewater and Taunton Canal.

Axe River, Somersetshire, is navigable from its mouth in Uphill Bay, Bristol Channel, eastward to Lower Weare, near Axbridge, a distance of nine miles. Near Loxton it is crossed by the proposed line of the Bridgewater and Taunton Canal.

Barnsley Canal begins in the river Calder, a little below Wakefield Bridge, and proceeds south and west over a track of fifteen miles and a half to its termination at Barnby Basin. In the first three miles it rises 120 feet by twenty-one locks, partly fed by a steam-engine. A great quantity of coal and paving-stone is conveyed by this canal. It connects the manufacturing towns in the west riding of Yorkshire.

Basingstoke Canal commences at Westley, in the Wey River, about two miles from the Thames, and proceeds westerly thirty-seven miles in Surrey and Hants, to the town of Basingstoke. It rises 195 feet in the first fifteen miles, by twenty-nine locks; the remainder is level.

Baybridge Canal, in the county of Surrey, proceeds from Binesbridge along the course of the river Arun to Baybridge, which is about three miles and three eighths. It rises fourteen feet, by two locks.

Birmingham and Fazeley Canal begins at the east end of the Old Birmingham Canal, near Farmer's Bridge, in Birmingham, and passes through a part of the town, thence by Newhall, Middleton Hall, and Drayton manor-house, to the Coventry Canal at Fazeley, near Tamworth, a distance of fifteen miles, with a fall of 248 feet. The remaining five miles and a half to Whittington Brook are level.

Birmingham (Old) Canal, twenty-two miles and a half long, proceeds from Farmer's Bridge, passes Smethwick and Oldbury. It then passes to the east of Tipton and Wolverhampton to the Staffordshire and Worcestershire Canal, near Autherley, where it descends 132 feet by twenty-one locks. The supply of water is chiefly drawn from old coal-mines by steam power. This canal communicates with the Worcester and Birmingham Canal at Birmingham, with the Dudley Canal near Tipton Green, and with the Wyrley and Essington Canal near Wolverhampton. By means of its canals, Birmingham communicates with the most important towns in England and Wales.

The Birmingham and Liverpool Junction Canal commences in the summit-level of the Staffordshire and Worcester Canal near Tettenhall, about a mile from Autherley, the place where the Birmingham Canal communicates with the Staffordshire and Worcester Canal. Its course is north-westerly to its termination in the United Navigation of the Ellesmere and Chester Canal near Dorford Hall. The total length is thirty-nine miles, with a fall of 175 feet by twenty-seven locks.

The Blyth River, Suffolk, is navigable from Halesworth Bridge to the haven of Southwold, about nine miles, descending by four locks.

The Bourn Eau River is navigable from the river Glen in Deeping Fen, for three and a half miles, in a north-west direction, to the town of Bourn.

The Bradford Canal extends from the Leeds and Liverpool Canal, near the village of Shipley, to the town of Bradford, a distance of three miles, rising eighty-six feet by ten locks, which are each sixty-six feet long and fifteen wide.

The Brecknock and Abergavenny Canal proceeds from the Monmouthshire Canal, about a mile south of Pontypool, and, crossing the river Avon by an aqueduct, continues for fourteen miles and a half on a level line to the west of Uske, whence it goes on to Brecon, eighteen miles and a half, with a rise of sixty-eight feet, the entire length being thirty-three miles. Various railways proceed from this canal to the different iron and coal works in that rich mineral district.

The Bridgewater Canal, which has already been noticed, may be called the root and model of canal navigation in England, being the first which crossed hill and valley in that country. The general direction of its principal line, which extends from Manchester to Runcorn-Gap, in the tide-way of the Mersey, amounting to about twenty-seven miles, is nearly south-west, in the counties of Chester and Lancaster, and, except the last 600 yards, in which there is a fall of eighty-two feet and a half by ten locks, the whole of this branch, together with twenty-eight miles of the other branches, and eighteen of the Grand Trunk Canal, into which it joins, in all seventy-three miles, are on one level. The determination of preferring one level led to the construction of such tunnels, aqueducts, and embankments, as were truly formidable in that infant state of canal operations. Nothing, however, could shake the fortitude and perseverance of the Duke of Bridgewater, or baffle the ingenuity of his talented engineer, James Brindley. The original design of the part of this canal first projected was for conveying coals from the duke's mines at Worsley to Manchester, a distance of about seven miles; but when the canal had reached the road from Warrington to that town, it was resolved to vary the line by crossing the river Irwell at Banton Bridge, and proceed to Manchester up the south side of that river, with a branch to Longford Bridge. From this latter place it was next proposed to carry the canal past Altringham, to the river Mersey, at Hempstones in Cheshire; but this line was partly changed, and the canal finally carried by Preston Brook to Runcorn. In 1795 an extension was made from Worsley Mill to the town of Leigh in Lancashire, with a branch to Chat Moss. The branches of this canal in the collieries under ground are together said to exceed eighteen miles in length.

It is said, that notwithstanding the great and increasing traffic upon the Liverpool and Manchester Railway, there has been no falling off in the canal business between these towns, but a considerable increase.

The Bridgewater and Taunton Canal has been projected to commence at Morgan's Pill in the river Avon, six miles below Bristol, and to pass south-westerly by Bridgewater to Taunton, a distance of forty-two miles and a half.

The Britton Canal commences in the river Neath, directly opposite the end of the Neath Canal, and runs south-west to Swansea Harbour in the river Tawe, a distance of four miles and a quarter.

The Bude and Launceston Canal commences in Bude Haven, within the port of Padstow, from which it runs south-easterly for five miles and three fourths to the Red Post, and thence easterly by a very crooked course of fifteen and five eighths farther to its termination at Thornbury. From the Red Post a branch of nineteen miles passes south by a very winding course along the west bank of the river Tamar to near Launceston. From Veala a branch of three miles and seven eighths passes to Virworthy; and another of one mile and a half from Burmsdon to Moreton Mill. Several inclined planes are used on this canal and its branches.

Bure River, Norfolk, is navigable from the town of Aylsham by a very crooked south-easterly course to its mouth in the Yare, near the sea at Yarmouth, a distance of forty miles by the river; at Horning Marsh it receives the Ant River, a navigable branch of eight miles, proceeding from the termination of the North Walsham and Dilham Canal at Wayford Bridge; and at Thurn it receives the Thurn River branch of seven miles from Hickling Broad.

Burn River, see Larke.

Bury River is a wide estuary entering from the west, between the southern parts of Carmarthenshire and Glamorganshire, and is navigable for about twelve miles inwards to the mouth of the River Loughor, which again continues the navigation two miles farther up the country northwards, and is joined by various railways.

The Bute Ship Canal commences in Cardiff Harbour, near the mouth of the river Taff, in Glamorganshire, running north to Cardiff Moors, and thence, parallel with the Glamorganshire Canal, to near Whitmoor Lane, on the south side of the town of Cardiff, where it terminates. The part from the commencement to Cardiff Moors is called the *Entrance Ship Canal*, and is almost two miles long, and 33 feet deep. The upper part, called the *Basin*, is about 1500 yards long, and twenty feet deep, with two short cuts to the Glamorganshire Canal.

Caister, see Ancholm.

Calder and Hebble Navigation commences at Fall Ing, near Wakefield, in the Aire and Calder Navigation, and proceeds, partly by the river, and partly by side cuts and locks and weirs, twenty-two miles, to Sowerby Bridge Wharf, near Halifax, where it enters the Rochdale Canal, having descended 192½ feet by twenty-eight locks.

The Caledonian Canal. A valley remarkable for its uniformity, straightness, and depth, and extending from sea to sea, between two parallel ranges of steep mountains, divides the Highlands of Scotland into two nearly equal parts. The general direction of this chasm is from north-east to south-west, making an angle of about 35 degrees with the meridian; and, besides being entered at each extremity by an arm of the sea, viz. by the Moray Frith on the north, and Loch Linnhe on the south, the rest of its bottom is for the most part occupied by a concatenation of rivers and lakes. The remarkably elongated form and contiguity of these lakes had long ago suggested the facility of forming an inland communication between the Atlantic Ocean and the German Sea. For, to accomplish this important object, it seemed sufficient to connect these lakes and the friths by several short canals, amounting together to twenty-three miles, and thereby obtain a navigable line to an extent of more than 100 miles; and this was farther recommended by the summit-level only rising ninety-four feet and a half above the sea. So far back as the year 1773, this line had been surveyed by the celebrated James Watt, who reported favourably of it, and proposed that the lakes should be connected by a canal of a very moderate size. Nothing farther, however, was done till early in the present century, when the subject was taken up by government, and new surveys were made by Messrs Jessop and Telford, who recommended a canal of such dimensions as should admit frigates of thirty-two guns, and the greater part of merchant ships, particularly that class which trade between the Baltic and the ports of Ireland and the west coast of Britain, as by this means a tedious and often dangerous navigation by the Orkneys would be avoided. The work was next set about at the public expense, and under the direction of Mr Telford, who gave to the undertaking the name of the Caledonian Canal. The dimensions then proposed by him, and which have been in a great measure adhered to, were a width of fifty feet at bottom, 120 at top, and a depth of twenty feet; the locks to be from 170 to 180 feet long, forty wide, with a depth of twenty feet of water besides the lift or rise. These measures have been followed in the case of the locks, but as yet the canal has only been excavated to the depth of fifteen feet in the summit-level, though the width has been slightly increased to 122 feet at top, but with a break in the slope such that there is on each side a horizontal shelf six feet broad at the depth of two feet under the surface of the water. The design of this break in the slope of the sides is to keep large vessels from approaching too close to the brink of the canal, and destroying the upper edge of the banks, either by contact or by the eddy produced between the vessel and the sides of the canal. It serves, besides, to prevent any loose earth which may crumble in at the margin from going down to the bottom, and retains it there till it be convenient to clean it out.

It was not deemed advisable that the rivers which flow through or from the lakes in the valley should form any part of this line of navigation; but on entering from the north we find the Caledonian Canal commencing with a sea-lock at Clachnacarry, in a sheltered bay of Loch Beauly, which is the more inland part of the Moray Frith. The sea-lock here is about two miles north-west of Inverness, and three quarters of a mile west of the well-frequented ferry of Kessock, which is near the mouth of the river Ness. In order to have sufficient depth of water at ordinary neap-tides, it was necessary, on account of the flatness of the shore, to place this lock about 400 yards within sea-water mark, an operation which was attended with no small difficulty, on account of the softness of the bottom. This lock is 170 feet long, forty wide, with a lift of eight feet and a half; and proceeding from it, the canal is formed by embankments till it passes the sea-mark, where another lock of the same size, with a lift of six feet, is built on firm ground. Next, on the south of this, is the Muirton basin, 967 yards long and 162 broad, with a wharf for the trade in that quarter, being about a mile from Inverness. At the southern extremity of this basin is a swivel or swing bridge for the public road between Beauly and Inverness; and then four locks, which, however, from their being connected, have only five double gates in the whole. These raise the canal thirty-two feet, which puts it on the ordinary summer level of Loch Ness. Each lock is 180 feet between the gates, and forty wide. From this the canal proceeds by gentle windings till it meets and runs along the north-west bank of the river Ness to the small lake Doughfour, which is about 2100 yards long, and from five to nine fathoms deep, and is six miles and a half from Clachnacarry. It communicates with Loch Ness by the pass of Bona Ferry. The intended line of canal being on the west side of the river Ness, which in three different places approached close to the steep sides of the hills on the west, it was necessary to alter the course of that river, so as to obtain room for the canal without cutting into the hills. At the entrance to Loch Doughfour is a regulating or guard-lock, without any lift, to prevent any overflow from the lake. It is 170 feet long, and forty wide. It was necessary to deepen this small loch in several places by dredging, and to raise it six feet to the level of Loch Ness by a wear and embankment. The next part of this navigation, and by far the most extensive lake in it, is Loch Ness, a fine sheet of water, about twenty-three miles and three quarters long, and from one to 1·5 mile broad. Its depth is so great that it never freezes, being from five to 129 fathoms, and along the middle it averages 100. It affords good anchorage at each end, and also in a few bays, although the sides of this lake are generally straight. It was proposed to introduce buoys for more convenient mooring. There are nowhere in it either rocks or banks detached from the shore.

Loch Ness receives the river Oich in its western shore, not far from its southern extremity, and a little south of this the canal leaves the lake, whilst almost quite at the southern end stand the fort and village of Fort Augustus. From this the canal ascends forty feet by five locks, and at Callachie, about two miles and a half farther on, it rises eight feet by another lock. Three miles more bring it to Loch Oich, where a regulating lock raises it thirty inches, so as to be even with that lake, which is on the summit-level.

To obtain a proper line for the canal upon the south-east side of the river Oich, the channel of that river has been somewhat altered. Loch Oich, which forms the summit-level of this navigation, is about three miles and three quarters long, and, on an average, a quarter of a mile broad. In one place in the middle, and at both ends, it had to be deepened by dredging. The water which falls into this lake, particularly from the river Garry, affords at all times an ample supply for the canal. Between Loch Oich and the next lake in the line, Loch Lochy, there is no natural communication. The interval is about a mile and three quarters, and rises twenty feet above Loch Oich, which, with the depth of the canal, required a cutting of thirty-five feet. Loch Lochy, which was twenty-one feet nine inches lower than Loch Oich, has been raised about twelve feet by an embankment to avoid rock-cutting, and the canal descends to it nine feet nine inches by two locks, one of which is also a regulating or guard lock. Loch Lochy is ten miles long, and averages one in breadth. In some places it is seventy-six fathoms in depth. About half a mile of the course of the river Lochy had to be shifted into a new bed to make room for the canal, which now, in its last stage, proceeds from the lake for eight miles along the north-west bank of that river over a rugged surface to the shore of Loch Eil, which is the more inland part of the frith called Loch Linnhe. A little south of Loch Lochy there is a regulating lock; and about a mile from Loch Eil there are eight connected locks, called Neptune's Stairs, by which the canal descends sixty-four feet. At Corpach shore it falls fifteen feet by two locks, and, after expanding into a basin 250 yards long and 100 broad, it finally descends seven feet nine inches by the sea-lock into Loch Eil, near Fort William.

The entire length of this navigation is sixty miles and a half, and that of the artificial part, including Loch Doughfour, is twenty-three miles and eight chains. There are in all twenty-eight locks. This canal has as yet been a most unprofitable speculation, for all it has hitherto yielded does not pay the mere expense of maintaining it. Foreigners affect to smile at the classic title of "Neptune's Stairs," which is not altogether free from vanity; but although many locks have certainly a greater lift, as, for instance, five locks rising together eighty-eight feet on the Leeds and Liverpool Canal, yet it is very unusual for gates to be so wide, and to descend twenty feet into the water, besides the eight feet of lift. The gates indeed descend five feet too low, and so do the locks, but this was done intentionally, in the expectation that the canal might yet be made five feet deeper. Amongst the wonders lately announced in Kentucky, we find locks thirty-eight feet wide, with a lift of sixteen feet. Such, however, will often spend just double the water in lowering a boat through the same height which locks with eight feet of lift would do, especially if none of the water can be withdrawn from the locks into side-ponds.

Cam, or Grant River, is navigable fourteen miles, from Cambridge to its mouth in the Great Ouse at Harrimere, above Ely. It is embanked above the fens in all its lower parts, and has sluices for making flashes of water, to enable boats to pass the shallows. There is a cut of three miles from it to Rehe, and another of three miles and a half to Burwell.

Camel River is navigable from Guinea Port, near Wade Bridge, to the sea at Stepper Point, three miles east from

Padstow, in the Bristol Channel, a distance of eight miles and a half by the low-water channel.

The Canterbury Navigation, or river Stour, from the city of Canterbury to the Downs at Sandwich Haven, having been very imperfect and incommodious, an act was obtained in 1825 for making various improvements on it; particularly a canal or harbour eight feet deep, from the Small Downs, commencing between the Batteries No. 1 and 2, to the river Stour at Sandwich, which is to be two and a half miles in length from the end of the proposed jetty of 1000 feet next the Downs; thence the navigation is continued in its old course sixteen miles to Fordwich, where there is a lock of six feet lift. From this to the tail of Abbots Mill, Canterbury, the length is two miles and a quarter, including three short cuts amounting together to one and a quarter mile. There is another lock of six feet lift half a mile from Canterbury. The total length is twenty miles and seven eighths.

Cardiff Canal, see Glamorganshire.

Carlisle Canal proceeds north-west from the west side of that city, and twice crossing the line of the Picts' Wall, continues by Kirk-Andrews to Wormanby, taking a westerly direction along the south side of the Picts' Wall, by Burgh; thence crossing the marshes, and passing by Drumburgh Castle and Glasson, it enters the Solway Frith at Fisher's Cross near Bowness. It is eleven miles and a quarter long, descending seventy feet by nine locks.

Carron River, Stirlingshire, is navigable from its mouth, in the estuary of the Forth, up to the village of Carron Shore, and thus far vessels drawing seven or eight feet water may ascend at neap tides; but still larger vessels come up for a shorter way to Grangemouth, where this river connects by means of a tide-lock with the Forth and Clyde Canal, and is indeed the only entrance to it from the Forth. But from the Carron Iron Works, which are situated farther up on this river, there is a cut southward to that same canal at the village of Bainsford.

Cart River, Renfrewshire, sometimes called the White Cart, is navigable for about five miles, from the town of Paisley northwards to the Clyde near Inchinnan; but this navigation is now in a great measure superseded by the Glasgow and Paisley Canal.

The Chelmer and Blackwater Navigation extends eastwards from the basin at Chelmsford to the tideway at Collier's Reach, a distance of thirteen miles and five eighths, partly by the course of the river Chelmer, and partly by cuts, viz. first, to Burleigh Mill, ten miles and seven eighths, with a fall of fifty-nine and a half feet; thence to Heybridge, one mile and an eighth, falling seven feet; and thence by a canal of one mile and five eighths to the basin at Collier's Reach, with a fall to low-water mark of twelve feet and two thirds. From this, the length of the estuary of Blackwater to the sea opposite Sales Point is about eleven miles.

Chester Canal, see Ellesmere.

The Chesterfield Canal commences in the tideway of the Trent at Stockwith, in Nottinghamshire, near the mouth of the Idle. The general direction of its crooked course is south-west to Chesterfield, a distance of forty-six miles, having a rise of 335 feet, and fall of eighty-five feet, with sixty-five locks. Between Harthill and the village of Wales there is a tunnel of 2850 yards on the summit-level.

Clyde River becomes navigable at Glasgow, and, proceeding thence westward by Govan and Renfrew, it receives the river Cart a little below that town. From this it gradually expands into a fine estuary, which, at Port-Glasgow, becomes fully two miles wide. Along the course of the river, the distance from Gorbals Bridge in Glasgow, to the mouth of the Cart, is about seven miles; thence to Bowling Bay, where it is joined by the Forth and Clyde Canal, four and a half; thence to Dumbarton harbour, three; and thence to Port Glasgow, five. But the total length of the navigable part of this river to where it falls into the Frith of Clyde opposite Roseneath, is about twenty-five miles. Under the act 6 Geo. IV. this navigation was to be made thirteen feet deep at neap tides. The trade upon it is very extensive.

Colne River is navigable from the Hythe, near Colchester, to the sea. From the Hythe to Wivenhoe the distance is three miles and a half, and thence the river expands into an estuary extending four miles and a half farther to the sea opposite the isle of Mersea.

Conway River, Denbighshire, is navigable in the tideway from Llanrwst to its mouth at Conway harbour, a distance of thirteen miles and a half.

Coombe Hill Canal extends from this village in Gloucestershire to Fletcher's Leap on the Severn, a distance of three miles and a half, falling fifteen feet.

The Coventry Canal commences at the Trent and Mersey, or Grand Trunk Canal, on Fradley Heath, whence it goes southerly to Huddlesford, being there joined by the Wyrley and Essington Canal. It next proceeds to Fazeley, near Tamworth, where the Birmingham and Fazeley Canal locks down into it. It then crosses the Tame by Amlington, approaching the Little Anker River, running parallel to it; then by Polesworth and Hartshill it proceeds to its termination at Coventry. The whole track just mentioned amounts to thirty-seven miles and three fourths, but of this the second five miles and a half from the north end now belong to the Birmingham Canal. From Fazeley to Atherstone, about ten miles, there is a rise of ninety-six feet, by thirteen locks.

Cree River is navigable about eight miles in the tideway from Carty, near Newton-Stewart, to Creetown, in Wigton Bay.

The Crinan Canal, in Argyleshire, runs nearly south-east from Crinan, in the Sound of Jura, to Ardreshaig in the frith of Loch Fine, and is about nine miles and a half long by from twelve to fifteen feet deep, with fifteen locks. From the west it rises fifty-nine feet to the summit-level, and then falls fifty-eight feet to the east. This short ship canal tends greatly to simplify and abridge the navigation in this quarter, as it cuts off about sixty miles from the long isthmus or tongue of land called Cantire, which vessels must otherwise double or go round.

The Cromford Canal, eighteen miles in length, proceeds from the head of the Nottingham Canal by Hynor Harly, Tadmoor, and Critch, to Cromford, near Matlock. In the first four miles it rises eighty feet, and the rest is level. It has several tunnels; one at Ripley is 2966 yards long.

Crouch River is navigable in the tideway from Hull bridge, in Essex, to its mouth in the sea at Foulness, a distance of sixteen miles.

The Croydon Canal commences in the Grand Surrey Canal, near Deptford, and extends nine miles and a half southward to Croydon. It rises about 150 feet, by twenty-six locks.

Darent River is navigable about four miles in the tideway from Dartfort to Longreach in the Thames.

Dart River is navigable about twelve miles and a half in the tideway from about a mile above Totness down to Start Bay in the English Channel.

The Dearne and Dove Canal commences in a side cut of the Don or Dunn River, between Swinton and Mexbourgh, and terminates in the aqueduct carrying the Barnsley Canal over the river Dearne. It is about nine miles and a quarter long, and rises altogether 127 feet, by eighteen locks.

Deben River, Suffolk, is navigable about nine miles and a half in the tideway from Wilford Bridge, about a mile above Woodbridge, down to the sea about four miles north of Harwich. At high water it has the appearance of a considerable estuary, and at Woodbridge and Rams-holt there are docks for ship-building and commodious wharfs.

Dee River, Cheshire, is navigable in the tideway for large vessels from Hand Bridge, at the city of Chester, by a new channel of eight miles, to where it enters the estuary of the Dee; and thence by the low-water channel to the opening into the Irish Sea off Great Helbre Island, which is a farther distance of fifteen miles and a half. At Chester this river connects with the Chester Canal.

The Derby Canal commences in the Trent, near Swarkstone, and about three furlongs to the north enters the Grand Trunk Canal, having risen twenty-six feet. From this to Derby, five miles and a quarter, it rises twelve feet, and, crossing the Derwent, proceeds three miles and a quarter by Little Chester and Breadsall, rising seventeen feet, to its termination at Little Eaton. From the east bank of the Derwent a branch extends eight miles and a half to the Erewash Canal, falling twenty-nine feet.

Derwent River, in Derbyshire, is navigable from the town of Derby, with a very tortuous course, till it falls into the Trent at Wilden Ferry, below Shardlow, where the Grand Trunk or Trent and Mersey Canal connects with that river. This navigation extends about thirteen miles.

Derwent River, in Yorkshire, is navigable from Yedingham Bridge to Barmby, in the tideway of the Ouse, about seven miles below Selby, a distance of forty-nine miles and a half, viz. from Yedingham Bridge to New Malton eleven miles and a half, thence to Howsham Hall nine and a half, thence to Stamford Bridge six and a quarter, and thence to the Ouse twenty-two.

The Donnington Wood Canal commences in the Shropshire Canal, near its junction with the Shrewsbury Canal, and runs north-east, for seven miles, to Pave Lane Wharf, near Newport.

Douglas Navigation, see Leeds and Liverpool.

The Driffield Navigation, eleven miles in length, commences at Aike Beck Mouth, in the river Hull, and ends at Great Driffield. The first five miles is in the Hull, and the remainder by a canal. The Hull and Leven Canal, of three miles, is a branch of this.

Droitwich Canal extends five miles and three quarters from Chapel Bridge, in that town, to Hawford, on the Severn, descending fifty-nine feet and a half, by eight locks. It is fed from salt springs.

The Dudley Canal proceeds from the Worcester and Birmingham Canal, near Selly Oak in Worcestershire, and passes a little east of Hales Owen, and north of Dudley, to the Old Birmingham Canal, near Tipton. From near Dudley it proceeds to the Black Delph and Stourbridge Canals. For the first ten miles and a half it is level to the Black Delph, thence two miles to Stourbridge it falls eighty-five feet by nine locks, and in three quarters of a mile to the Dudley tunnel it rises thirty-one feet by five locks. Through the 2926 yards of the tunnel it is level; thence, in one furlong, to Old Birmingham Canal, it falls thirteen feet by two locks. The main line is thirteen miles long. There are two more tunnels, one at Lapal of 3776 yards, and another at Grotsy Hill, 623 yards.

The Dun River Navigation, consisting of parts of the river Dun or Don, and short pieces of canal alternately, commences in the Ouse at Goole Bridge, and extends south-west about thirty-nine miles to Tinsley, near Sheffield, where it is joined by the Sheffield Canal. The total rise is ninety-two feet and a quarter, by sixteen locks.

Eden River has been made navigable ten miles and a half in the tideway from Carlisle Bridge, by Kirk-Andrews and Rockcliff, to Burgh Marsh Point, where it empties itself into the Solway Frith. It has been in some measure superseded by the Carlisle Canal.

The Edinburgh and Glasgow Union Canal has its western extremity at lock No. 16 of the Forth and Clyde Canal, from the south-eastern bank of which it rises 110 feet, by eleven connected locks, to a height which enables it to be continued for thirty-one miles wholly on one level to its termination at Edinburgh. These locks are a little west of Falkirk, which the canal passes on the south, proceeding eastward through Prospect Hill tunnel of 696 yards in the solid rock, then over the Avon by a stupendous aqueduct bridge eighty feet above the water of that river. This is about two miles west of Linlithgow, which the canal passes close on the south, and continuing east six miles farther, turns south past the villages of Winchburgh and Broxburn, and then east again to the aqueduct bridge by which it crosses the river Almond; thence by Ratho to another aqueduct bridge at Slateford over the Water of Leith; and finally, to Port Hopetoun Basin at Edinburgh. This canal is forty feet wide at top, twenty at bottom, and five deep. The late Mr Telford recommended to continue the line of this canal from Falkirk to lock No. 20, at the eastern extremity of the Forth and Clyde summit, and to reserve the more depressed junction at No. 16 for the Grangemouth trade only. By this mode about nine fewer locks would need to be passed in the journey between Edinburgh and Glasgow; and both canals would require less water, especially as the Union Canal would then throw a large quantity of water into the summit of the Forth and Clyde Canal, which the latter now receives at too low a level to be of any use.

The Ellesmere and Chester Canal begins at Ellesmere Port in the tideway of the Mersey, about ten miles south-east of the port of Liverpool, proceeding south by Stoke, Wervin, and between Moston and Mollington Hall to Chester, where a short branch locks down into the river Dee. From this it passes east by the north wall of the city, then more southerly by Christleton and Beeston Castle, to Wardle Green, from which a branch goes to join a branch of the Grand Trunk at Middlewich. The main line proceeds a mile and a half from Wardle Green to near Hurleston, whence another branch proceeds to near Darford Hall near Nantwich, and connects with the Birmingham and Liverpool Junction Canal. From Hurleston the main line proceeds southward by Burland to Woodcot, and thence westward to near Whitechurch, where the canal enters Shropshire. Next, passing close by a detached part of Flintshire, it reaches the Cottage; and then continuing westerly by the south side of Ellesmere, to which there is a short branch, it turns more southerly to Francton Common, where the Llanymynech branch proceeds from it to the Montgomeryshire Canal. The direction of the main line is again westerly by Halston Hall, crossing the river Ceiriog by a fine aqueduct, then through Chirk Tunnel to the river Dee, which it passes by means of the famous cast-iron aqueduct bridge at Pont-y-Cysylte. (See the article Aqueduct.)

The entire length of the main line from the Mersey to the Montgomeryshire Canal is sixty-one miles, viz. to Chester, eight miles and a quarter, with a rise of forty-six feet; to Hurleston Locks, fifteen miles and three quarters, with a rise of 131 feet; to Francton Common, twenty-five miles, with a rise of 115 feet; and to the Mongomeryshire Canal, eleven miles and a half, with a fall of fifty-two feet. The branch to meet the Birmingham and Liverpool Junction Canal is two miles, and level. The branch from the Cottage to Edstaston Wharf is three miles; the branch to the town of Ellesmere is one furlong; the branch to the Ruabon Brook Railway is fully eleven miles; and that from Wardle Green to the Grand Trunk is nearly ten miles, with a fall of forty-four feet. This navigation, considering its extent, is remarkable for having been principally undertaken for agricultural purposes, the supply of towns and manufactories being a secondary consideration, though these have been greatly benefited by it. For many other particulars, see Priestley's Account of Canals.

The English and Bristol Channels Ship Canal was projected principally with the view of shortening and rendering more certain and expeditious the passage of vessels trading from the Bristol Channel, the ports of Ireland, and the western ports of Britain, to the English Channel. Its length is to be forty-four miles and five eighths from its southern extremity, at Beer Roads, Seaton Bay, in the English Channel, to the northern, in Bridgewater Bay, in the Bristol Channel, which is shorter by fully 220 miles than going round the Land's End. The width is to be ninety-feet, with a depth of fifteen.

The Erewash Canal proceeds from the Cromford Canal, near Langley Bridge, to the Trent, near Sawley Ferry, being eleven miles and three quarters long, with a fall of 109 feet. The Nut-Brook Canal proceeds from the middle of this, and farther down it receives a branch of the Derby Canal, and near Sawley the Trent Canal.

The Exe River and Exeter Canal. The estuary of the Exe is navigable for eight miles, from Exeter up to the town of Topsham, and a little above this a canal proceeds from the river, running fully three miles up its west side. It is said that the first lock constructed in England was on this navigation, in 1675. But in 1829 an act was passed for making the canal enter the estuary at the Turf, two miles lower down, which will increase its length to five miles, with a depth of fifteen feet.

Forth River begins to be navigable at Stirling Bridge; but the tide reaches a little farther, to Craigforth Mill. From this downward the windings of the river are singularly intricate; its course to Alloa measuring more than three times the direct distance, which is only seven miles. On this account, although vessels of from sixty to seventy tons have water enough to Stirling, it is visited by few excepting steamers. About three miles above Alloa the Forth receives the river Devon, which is itself navigable for a short way, and very susceptible of great improvement. From this the Forth gradually expands into an estuary two miles wide opposite the mouth of the Carron, which is at the distance of thirty miles from Stirling by water. This estuary, called the Frith of Forth, continues eastward about forty-six miles farther to the Isle of May, where it may be reckoned to enter the German Sea.

The Forth and Clyde Canal commences in Grangemouth harbour, in the small river Carron, about two miles by the low-water channel, above its mouth in the estuary of the Forth. The general direction of this canal is that of west by south. It at first runs a considerable way on one level along the south side of the Carron, with which it again communicates by a cut from it at Bainsford, to that river at the Carron Iron-Works. The main line then passes to the north-west of Falkirk, and thence to Bonny Bridge, proceeding by the south side of Kilsyth, and along the south bank of the river Kelvin, and over the Logie Water by a stone aqueduct at Kirkintilloch. It then reaches Hamilton Hill about two miles from the north-west quarter of the city of Glasgow, to which there is a branch of two miles and three quarters, communicating with a branch from the Monkland Canal at Port-Dundas basin. The main line now proceeds westerly, crossing the Kelvin by a noble aqueduct, and then runs along the side of the Clyde, till it at length locks down to that fine river at Bowling Bay. The main line is thirty-five miles long, fifty-six feet wide at top, twenty-seven at bottom, and ten feet deep. In ten miles and three quarters from Grangemouth to the summit, it rises 156 feet by twenty locks. The summit-level continues about sixteen miles, and from it to the Clyde there is a descent of 156 feet by nineteen locks. Each lock is seventy-four feet long by twenty wide. At lock No. 16 from Grangemouth, this canal connects with the Edinburgh and Glasgow Union Canal.

Few canals have proved so lucrative as the Forth and Clyde. Instead of having its eastern extremity in the Carron, it was originally intended to have had it considerably farther east, or lower down the Forth, in the deeper water at Borrowstownness. This would certainly have been an immense improvement, but probably not so easily executed as some imagine; for the work was really once considerably begun, and after all abandoned, chiefly, we presume, from the difficulty of passing over the river Avon, without raising the canal a good deal for several miles along the low carse lands. The remains of a bungled aqueduct bridge for this purpose were lately to be seen on the banks of that river.

The Foss Navigation, in the north riding of Yorkshire, follows the course of the river Foss from Stillington Mill, partly in that river and partly by canal, for about twelve miles and a half, to the Ouse, at York, descending forty-seven feet and two thirds.

Foss-dike Navigation commences in the Trent, at Torksey, continuing south-east on one level for eleven miles, through a flat country, to Brayford Mere, near Lincoln High Bridge, where it is joined by the river Witham; and about five miles west of Lincoln it receives the river Till. At Torksey is a double lock, with gates pointed both ways. This canal is supposed to have been first executed by the Romans.

Gippen or Gipping River has been made navigable from near Stowmarket for sixteen miles in a south-easterly direction, to where it falls into the tideway of the Orwell, on the south side of the town of Ipswich, near Stoke Bridge. From this the estuary of the Orwell extends about twelve miles to the sea at Landguard Fort.

Glamorganshire or Cardiff Canal commences about one mile and a half below Cardiff, on the east side of the river Taff, near its entrance into Penarth harbour. It runs north-west, parallel with the Taff, by the city of Landaff, crossing the Taff by an aqueduct bridge, and it is then joined by the Aberdare Canal. Still keeping up the vale, it reaches its termination at Merthyr Tydvil; the total length being about twenty-five miles, with a rise of 611 feet.

The Glasgow, Paisley, and Ardrossan Canal, though originally intended to connect these places, and to be thirty-two miles and three quarters long, has as yet only been executed for twelve miles. It begins at Port Eglinton, near Glasgow, proceeding westerly by the north bank of the White Cart River, along which it continues till near Paisley, where it crosses that river, and then passes on the south of that town to its termination at Johnstone. It is twenty-eight feet wide at top, fourteen at bottom, four and a half deep, and all on one level. The excavation of the rest of the canal seems to be quite laid aside; but the line is to be continued to Ardrossan by a railway now in the course of being constructed.

Glastonbury Navigation begins at the confluence of the rivers Brue and Parrett, in the Bristol Channel, running along the course of the Brue to Highbridge, and is to be continued by a canal, partly in that river, to the west side of the town of Glastonbury, in all fourteen miles and a quarter.

Glenkenns Canal, on the Solway, though described in various books for the last thirty-five years, has never yet been executed.

The Gloucester and Berkeley Ship Canal begins in the Severn, at Sharpness Point, about three miles north of the town of Berkeley, proceeding by Slimbridge and Saul, and, crossing the Stroud Canal on the same level, it passes Wheatenhurst, Hardwick Court, and Hempstead House, and reaches the city of Gloucester, where it terminates in a spacious basin, out of which there is a lock into the Severn. The distance between Sharpness and Gloucester by the Severn is twenty-eight miles, whilst by the canal it is only sixteen and a half, and avoids a difficult and often dangerous navigation. The width of this canal is seventy feet, depth eighteen, and it is level throughout.

The Grand Junction Canal proceeds from the Thames at Brentford, across the Brent rivulet, to the valley of the Colne, which it continues to follow past Uxbridge, Rickmansworth, Walford, King's Langley, Two-Waters, Berkhampstead, to the summit-level at Cowroast; being thirty-five miles and three eighths, with a rise of 395 feet, and through an almost continued series of mill pools. The summit-level extends only three miles and three fourths to Tring, and is chiefly in deep cutting. From Tring the canal continues by Marswath, near to Leighton Buzzard and Fenny Stratford, to the Ouse at Wolverston, near Stony Stratford, a distance of twenty-five miles and a quarter, with a descent of 192 feet. Here it crosses the Ouse on a small aqueduct, and an embankment half a mile long. Then running along the western side of, and having crossed the Five Rivers, the canal arrives at Stoke-Bruern, being a distance of six miles and a half, with a rise of 112 feet. It next goes through Blisworth tunnel, of 3080 yards, proceeding by Western Beck to the southern extremity of Whitton parish, being thirteen miles and a half, on one level. In three quarters of a mile from this to Whitton Mill it rises sixty feet, and then continues level for four miles and a quarter, to the farther extremity of Braunston tunnel, of 2045 yards. It is seven eighths of a mile, with a fall of thirty-seven feet, from this tunnel to the junction with the Oxford Canal. The total length of the main line of the Grand Junction between the limits now mentioned is ninety miles and a quarter. Its average width is forty-three feet, and depth from four and a half to five feet. The locks are eighty-two feet long by fourteen and a half wide. The Paddington branch, of thirteen miles and a half, is of the same dimensions. It connects with the main line about midway between Uxbridge and Brentford, and again with the Regent's Canal at Paddington. From Tring a level branch of six miles and three quarters reaches near Wendover; and, a little north of Tring, a branch of six miles goes to Alyesbury, falling ninety-five feet. From the embankment over the Ouse, a branch of nine miles and a half proceeds to the town of Buckingham; and another of nine miles from Gayton, by Old Stratford, to the Nen, near Northampton. By means of the Grand Junction a communication has been opened between London and the great manufacturing districts in the interior of the kingdom.

The Grand Surrey Canal commences at Wilkinson's Gun Wharf, on the south bank of the Thames, about a quarter of a mile east of the Thames Tunnel, and passing 1200 yards through the docks of this navigation, its course is southward, approaching at Bridge Place within 250 yards of the King's Dock Yard at Deptford, near to where it is joined by the Croydon Canal. It then turns west by Peckham New Town to the north side of Adlington Square, where it terminates. It is four miles and two chains in length.

Grand Trunk, see Trent and Mersey.

The Grand Union Canal unites with the Leicester Union Canal near Foxton, about four miles from Market Harborough, to which there is a branch. Its course is southerly, passing through a tunnel of 1166 yards at Bosworth, between Lutterworth and Northampton, and thence by Elkington and Guildsborough to Crick, at which there is a tunnel of 1524 yards. Then leaving Watford on the east, it continues to its termination in the Grand Junction Canal at Long Buckby. The entire length is about forty-five miles, with an ascent of seventy-six feet by ten locks, and a fall of fifty-four feet by seven locks.

Grantham Canal commences at the town of that name in Lincolnshire, passing Harloxton, Woolsthorp Point, Stainwith Close, Cropwell Butler, to its termination in the river Trent, nearly opposite the mouth of the Nottingham Canal. The length is about thirty-three miles, with a fall of a hundred and forty-seven feet and a half. A branch of three miles and a half goes to the town of Bingham.

Gresley Canal forms a short connecting portion between or in the line of the Newcastle-under-Line Canal and the Newcastle-under-Line Junction Canal, the principal purposes of which are for conveying coals from the Apdale and Partridge Collieries on the west, and the Caldon line from the east.

The Hartlepool Ship Canal connects the Hartlepool harbour with the sea. It is 300 yards long, and nineteen feet deep, being cut through the solid rock.

Hereford and Gloucester Canal commences in the Severn opposite Gloucester, crosses Alney Isle and another branch of the Severn to Lassington, and terminates at Byster's Gate in Hereford. In eighteen miles from the Severn to Ledbury it rises 195½ feet, and then continues on the summit-level eight and a half miles to Monkhide, from which it descends thirty feet in three miles to Withington March, and thence to Hereford, six miles, it is level. The total length is thirty-five miles and a half, with three tunnels of 2192, 1320, and 440 yards respectively.

Hertford Union Canal is a cut of one mile in length, to connect the Hackney Cut of the River Lea Navigation at White-Post Bridge, near Temple Mills, with the Regent's Canal at Old Ford Lock, Bethnal Green. It is also called the Lea Union and Sir George Duckett's Canal.

The Horncastle Navigation commences in the Old Witham River, near Tattershall, Lincolnshire, and, partly occupying the bed of what was formerly the Tattershall Canal, proceeds to Horncastle by the course of the Bain River. It is about eleven miles long, and very little elevated above the sea.

Huddersfield Canal commences on the southern side of that town, running south-west by Slaithwaite, nearly parallel with a branch of the Colne, for seven miles and a half, which river it crosses three times by aqueducts; and, ascending 436 feet by forty-two locks, it attains, near Marsden, the highest summit-level in the island, being 656 feet above the sea, but only four miles long. This is principally occupied by the Standedge tunnel, of 5451 yards, which is upwards of three miles, being the largest in Britain, from which the canal emerges into the vale of Diggle in Saddleworth, to near Wrigley Mill. It then glides along the valley alternately on the north and south sides of the River Tame, past Dobcross, Scout, and Stayley Bridge, to its junction with the Manchester, Ashton, and Oldham Canal, near Duckinfield Bridge; having passed a farther distance of eight miles and a quarter, with a descent of 334½ feet by thirty-three locks. There is a tunnel at Scout of 240 yards, and another at Ashton of 198 yards. This canal forms part of the shortest water communication between the east and west coasts.

Hull River, see Driffield.

Itchin Navigation follows the course of the river Itchin from Blackbridge, near the city of Winchester, to the tideway at Northam, near the town of Southampton, a distance of fourteen miles.

Ivel River, which empties itself into the Ouse at Tempsford in Bedfordshire, has been made navigable for five miles and three fourths, up to Biggleswade; and it has long been proposed to extend it five miles and a quarter farther, up to Shefford.

Ivelchester and Langport Canal, in Somersetshire, is nearly seven miles long, running eastward from its commencement in the river Parrett, below the town of Langport, to Ivelchester or Ilchester.

Kennet and Avon Canal commences at the head of the navigable part of the river Kennet, at Newbury in Berkshire, and passes up the valley of that river by Hungerford and Great Bedwin to Crofton, a distance of sixteen miles and a half, rising 210 feet by thirty-one locks. From this the summit-level continues two miles and a half, through a tunnel of 510 yards, to Brimslade. In one mile farther there is a descent of thirty-three feet by four locks to Wootton-Rivers, from which the canal continues fifteen miles along the vale of Pewsey, on one level, to Devizes; and in the next two miles and a half to Foxhanger it falls 239 feet by twenty-nine locks. Other four miles and a half, descending fifty-six feet by seven locks, bring it to Semington, where it is joined by the Wilts and Berks Canal. From this it passes five miles and a half to Bradford, and there descends ten feet by one lock into the vale of the Avon, along which it continues nine miles on one level to Sidney Gardens, Bath; and in about a mile farther it descends sixty-six feet and a half by seven locks into the Avon, near the Old Bridge. From this the Avon itself is navigable downwards by Bristol into the Severn. The entire length of the canal is fifty-seven miles; the breadth is forty-four feet at top, twenty-four at bottom; and the depth is from five to six feet. Few canals afford more specimens of deep cutting, aqueducts, and tunnels, than the Kennet and Avon. It completes a circuit of navigable canals, which, traversing the northern, midland, and southern counties of England, connect its four largest rivers, the Trent, the Mersey, the Severn, and the Thames. Thus, by uniting the rivers Kennet and Avon, the former of which runs into the Thames at Reading, and the latter into the Severn a few miles below Bristol, this canal becomes the central line of communication between the Irish and the German Seas.

Kennet River has been made navigable from where it falls into the Thames, about a mile and a half below Reading, up to its junction with the Kennet and Avon Canal at Newbury, in Berkshire, a distance of twenty miles. It ascends 126 feet, by twenty locks.

Kensington Canal, 3000 yards long, consists of Counters Creek, greatly enlarged and improved, its mouth being in the Thames, near Counters Bridge, on the road from London to Hammersmith.

Ketley Canal, see Shropshire.

Kingston Canal, see Leominster.

Lancaster Canal commences at Bark Hill, near Wigan, passing Chorley to Clayton Green, near the south bank of the river Ribble, a distance of thirteen miles and a half, which is level. From this across the valley of the Ribble to the top of its north bank the distance is four miles and a quarter, with a depression of 222 feet, which is passed by a railway and inclined plane on each side of the valley. From this railroad, past Garstang and Lancaster to Tewitfield, near Barwick, a distance of forty-two miles, the line of the canal is on one level, and is commonly called the Lancaster Level. In the next thirteen miles, to its termination at Kirkby-Kendal, it rises sixty-six feet. The general direction of this canal is north, and the entire length about seventy-three miles. It has a magnificent aqueduct over the river Lune, near Lancaster, being fifty-one feet above the river, and having five arches of seventy feet span each.

The Larke or Burn River, in Suffolk and Cambridgeshire, is navigable for fourteen miles, from Long Common, a little below Milden Hall Mill, to Eastgate Bridge, in Bury St Edmunds. Being connected with the Ouse, near Littleport, it is a very useful navigation.

Lea River Navigation commences at the town of Hertford, proceeding easterly by Ware to its junction with the Stort River Navigation, near Hoddesden, from which it veers south to Waltham Abbey, and preserves the same direction to Oil Mill, where, again bending south-east by Wanstead and Aldersbrook, it arrives at Temple Mills. A little above this it is connected with the Regent's Canal by a cut of one mile, called the Hertford or Lea Union Canal. From Temple Mills the Lea proceeds to its descent into the Thames at Bow Creek. At Bromley there is a cut of one mile and a half, falling seventeen feet and a half into the Thames at Limehouse. The track of the Lea from the Hertford to the Thames is about twenty-six miles; and connected with it is the canal called the New River, which supplies London with water.

The Leeds and Liverpool Canal commences at Leeds Bridge, where it unites with the Aire and Calder Navigation, and terminates at North Lady's Walk, Liverpool, a distance of $127\frac{1}{6}$ miles. In the course of forty-one miles from Leeds to the summit-level, near Greenberfield, the total rise is 411 feet; from the summit near Colne, to the basin at Liverpool, there is a fall of 433 feet; and from the basin to low water in the Mersey the fall is fifty-six feet. It is to be observed, that of this line of navigation eleven miles belong to the Lancaster Canal; that is, from Cophurst, or Johnson's Hillock, to Kirklees. The great tunnel of Foulridge is 1640 yards long, eighteen feet high, and seventeen wide. At Bingley, a connected series of five locks effect the enormous lift of eighty-eight feet and two thirds, which must often occasion a great waste of water, unless recourse be had to some additional artifice. This canal was forty-six years in hand, being begun in 1770, and finished in 1816.

The Leicester Navigation commences at the basin of the Loughborough Canal, and proceeds three miles to the separation of the Melton-Mowbray Navigation. (See Wreak and Eye Navigation.) From this the distance is eleven miles, with a rise of forty-five, to its termination in the Leicestershire and Northamptonshire Union Canal.

The Leicestershire and Northamptonshire Union Canal, commencing at the junction with the Leicester Navigation, proceeds partly in the bed of the river Soar, and partly by an artificial course, to the Grand Union Canal at Gumley Hall, a distance of seventeen miles, rising 160 feet. From the last place a branch of four miles goes to Market Harborough. There is a tunnel half a mile long at Saddington.

The Leominster Canal commences at Kington, $505\frac{1}{2}$ feet above the sea, where it meets the Kington Railway; thence observing an easterly direction, it passes to the aqueduct over the Lugg at Kingsland, and then bends south to near Leominster. From this town it runs north for a considerable distance past Berrington House, then turns east with many windings past Tenbury to the aqueduct over the Rea, and the tunnel at Sousant, which is 1250 yards long. From the latter, which is $264\frac{1}{2}$ feet above the sea, the canal runs eastward to its termination at Stourport, where it unites with the Severn and the Stafford and Worcester Canal, having described a track of forty-six miles. From Kington to Staunton Park it is level for four miles, then falls 152 feet in two miles and a half to Milton, thirty-seven feet in three miles and a half to Kingsland aqueduct, and sixty-four feet in four miles and a half to Leominster. In the next mile and a half it rises eighteen feet, and in five miles and a half farther to Wiston it is level; thence to Letwich Brook it falls thirty-six feet in four miles and a half. The next seven miles to Rea are level, then is a rise of thirty-five feet in one mile to Sousant tunnel, then nine level miles to Great Pensax tunnel of 3850 yards. But in the last three miles to the Stafford and Worcester Canal there is a fall of 207 feet; the total fall being 496 feet, and the rise forty-eight.

The Leven Canal is a cut of three miles from the village of Leven to the Driffield or Hull River Navigation.

Lewes, see Ouse River, Sussex.

The Liskeard and Looe Canal commences at Tarras Pill, and runs northward to Moorswater, in the parish of Liskeard, in Cornwall. It is five miles and seven eighths long, rising 156 feet by twenty-five locks. It has a branch of one mile to Sand Place.

Louth Canal runs from that town northwards by Leatherhill Mead and North Cockering to Titney, in the mouth of the Humber, a distance of fourteen miles, falling fifty-six feet and a half.

The Loyne or Lune River is navigable about seven miles in the tideway from Lancaster Bridge to its mouth in Lancaster Bay.

Lynn River, see Narr.

Macclesfield Canal commences near the north end of the summit-level of the Peak Forest Canal, and passes through a very undulating part of Cheshire to the road from Buxton to Congleton, where it locks down to its lowest level; then crossing the Dane, it runs south-west to its termination in the summit-level of the Trent and Mersey Canal, a distance of twenty-nine miles and a half, with a total fall of 113¾ feet. This, when executed, will shorten the communication between London and Manchester about thirteen miles.

Manchester, see Ashton.

The Manchester, Bolton, and Bury Canal ascends sixty-eight feet and one third, by six locks, from the Irwell to the basin in Salford; thence for four miles running parallel to the Irwell it is level, but in the next three miles it rises 121 feet by twelve locks. The remaining four miles to Bolton are level, and so is a branch of four miles to Bury.

Market Weighton Canal commences at New River Head, near Market Weighton, and runs almost directly south for eleven miles to its termination, with a sea-lock at Foss-dike Clough, in the Humber. Near the upper end are three locks.

The Medway River begins to be navigable for barges at Penhurst Bridge, about six miles above Tunbridge, and about forty-five miles by the crooked course of the river, from its mouth in the Thames at Sheerness; but some deduction should be made for several bends being now cut off. The tide formerly reached up to Maidstone, but has been obstructed by locks and weirs. Below Rochester Bridge this river is in many places of great width, and so deep as to float the largest vessels at low water, thus affording a safe and extensive harbour for Chatham dock-yard. A little below Rochester Bridge it is joined by the Thames and Medway Canal, and near its mouth by the East Swale or tide passage round the south side of the Isle of Sheppey.

The Mersey and Irwell Navigation commences in the estuary of the Mersey at Runcorn Gap, and terminates at the bridge between Manchester and Salford. It consists in these rivers improved by locks, weirs, and extensive side-cuts, so as to be conveniently navigable over a distance which by the course of the rivers exceeds fifty miles. The various canals connected with the Mersey and Irwell render this an undertaking of great utility.

The Monkland Canal begins at Old Monkland Colliery, and runs nearly direct west for twelve miles to Port Dundas at Glasgow, where it communicates with a branch of the Forth and Clyde Canal, to which it acts as a feeder. In its course it receives the Monkland and Kirkintilloch, Garnkirk and Glasgow, and Airdrie Railways. At Sheepford it falls twenty-three feet by two locks, and at Blackhill ninety-six feet by twelve locks. It is thirty-four feet wide at top, twenty-four at bottom, and four and a half deep.

Monmouthshire Canal commences in the Usk River, a little below Newport, close to the termination of the Rumney and Sirhowey Railways. Passing northward, this canal extends by Pontypool to Pontnewynydd, a distance of fully seventeen miles and three quarters. Near the latter place it connects with the Abergavenny and Brecknock Canal. In the last twelve miles it rises 447 feet; and, opposite Malpas, a branch of eleven miles, rising 358 feet, goes to Crumlin Bridge. There are various extensive railway branches from this canal.

Montgomeryshire Canal commences at Portywain lime-works, where it joins a branch of the Ellesmere Canal; and having passed the village of Llany-mynach, and crossed the Verniew River, it joins another branch of the Ellesmere Canal. Next running to Gwern-felu, where a branch to Guilsfield turns off, it proceeds to Welchpool; after this it runs parallel to the Severn, which it at length joins on the east side of Newton. It is about twenty-seven miles long, running in a south-west direction, with a lockage of 225 feet.

Narr or Lynn River is navigable from the Ouse at King's Lynn to Castle Acre in Norfolk, a distance of about fifteen miles.

Neath Canal commences in the tideway of the Neath, at Giant's-grave-pill, in Briton's Ferry, and running north-west, terminates in the Aberdare Railway branch at Abernaut, a distance of fourteen miles. It has various other railway branches to the neighbouring collieries, &c.

Nen or Nyne River is navigable from the sea below Wisbeach, through the Fens to Peterborough, and from that by the natural channel, improved by cuts and locks, to Northampton, which forms a course of about ninety-nine miles. Beginning in the Wash at Peter's Point, and passing up nine miles to Wisbeach, the navigation may either be continued thence to Outwell by the course of the river, or by the still shorter track of the Wisbeach Canal, which also forms a communication between these places. But the navigation likewise proceeds from both places by two or three embanked courses through the Fens to Peterborough, a farther distance of forty miles; and thence by the original channel, greatly improved by cuts, weirs, and locks, for fifty miles more, up to the town of Northampton, to which a canal branch descends 112 feet from the Grand Junction Canal. Near Salter's Load the Nen communicates with the Ouse by means of Well Creek; and a still shorter navigation has been formed from Wisbeach to Lynn, through the Wisbeach Canal. The above may give some idea of the principal lines of navigation belonging to this river; but since most of the rivers and navigable drains in the fens are embanked on both sides, and since they are almost still water too, this occasions such a number of navigable branches intersecting and crossing in all directions, that a description of them would greatly exceed our limits.

The Newcastle-under-Line Canal extends about three miles westward, from the Trent and Mersey Canal at Stoke-upon-Trent to Newcastle, in the Newcastle-under-Line Junction Canal, which again continues the line north-west for eight miles farther (including in its middle the five miles of Gresley's Canal) to Partridge-Nest and Bignel-End Collieries.

The Newport Pagnell Canal is a branch of a mile and a quarter from that town to the Grand Junction Canal at Linford, with a rise of fifty feet by seven locks.

Nith or Nidd River Navigation commences in the Solway Frith, and extends nearly north for about nine miles in the tideway between the counties of Dumfries and Kirkcudbright, to Dumfries Bridge; but it stands much in need of improvement.

North Walsham and Dilham Canal commences at Wayford Bridge, in the parish of Dilham, Norfolk, in the river Ant, and runs north-west by North Walsham and Whitton Park, to its termination at Antingham, a distance of seven miles.

North Wilts Canal, see Wilts and Berks.

The Norwich and Lowestoff Navigation, commencing in the Wensum or Yare River at Norwich, follows partly the course of that river, and those of the Yare and Wensum, and proceeds partly through the Lake Lothing, and by cuts to Lowestoff, a distance of thirty miles. It traverses so flat a country, that a tide-lock only is necessary, which admits vessels eighty-four feet long, twenty-one wide, and drawing ten feet of water.

Nottingham Canal commences in the Trent, from which it has a winding course for about fifteen miles, with a rise of 108 feet to the junction of the Erewash and Cromford Canals at Langley Bridge.

Nutbrook or Shipley Canal is a branch extending four miles and a half, from the Erewash Canal, near Trowen, to the Shipley Collieries.

The Oakham Canal extends from that town to Melton-Mowbray on the Leicester and Melton-Mowbray Navigation; a distance of fifteen miles, falling 126 feet.

Ouse River, Sussex, navigable naturally nine miles in the tideway up the Lewes, has, by artificial means, been rendered navigable for twenty-two miles farther, up to Hammer Bridge.

Ouse River, Yorkshire, is navigable for vessels of 150 or 160 tons from where it receives the Trent, up to the junction of the Aire and Calder Navigation at Armyn, a distance of fifteen miles, and for smaller masted vessels twenty-five miles farther to the city of York. This river, notwithstanding its limited trade above that city, has such an immense traffic in the lower part, by reason of the numerous rivers and canals communicating with the manufacturing and mining districts, that it undoubtedly ranks the second river in the kingdom in importance and utility; whilst, by its union with the Humber, merchandise is exported to and imported from all parts of the globe.

Ouse River Navigation (Bedford Level) commences in the estuary of the Wash, below the town of Lynn, and proceeding thence by a cut of two miles and three quarters, called the Eau Brink, to Salter's Load and Denver's Sluice, it is thus far, which is about seventeen miles above Lynn, an open embanked navigation. From this upwards the natural river continues navigable still by an embanked crooked course through the Fens to Ely and Hermitage Sluice near Erith, and thence onward to Bedford, altogether about eighty-four miles from the sea. From Lynn the Narr or Lynn has been made navigable fifteen miles to Castle Acre in Norfolk; and from Salter's Load the Well Creek extends to the Nen and Wisbeach Navigation. Near Denver's Sluice the Ouse receives the river Stoke, also the Old and New Bedford Rivers, which are two parallel straight cuts of twenty-one miles, joining the Ouse again at Hermitage Sluice. From this last place a navigable cut of twelve miles conveys water from the Ouse to the Nen at Benwick. At Brandon Creek Bridge the Ouse receives the Little Ouse, which is navigable for twenty-two miles and a half south-east by Downham and Santon to Thetford; and at Prickwillow it receives the Larke, navigable to Bury St Edmund's. Near Barkway the Soham Lode, navigable for four miles to Soham, falls into the Ouse. At Harrimere it receives the Grant or Cam, navigable to Cambridge, and at Tempsford the Ivel. Almost the whole of the rivers and large drains connected with the Ouse are embanked and nearly level. Many others of them are navigable for short distances besides those we have noticed, but they are chiefly used for drainage.

The Oxford Canal commences in the Coventry Canal at Longford, proceeding thence twenty-six miles and a half on one level across the upper part of the valley of the Avon to near Hill Morton, where it rises nineteen feet by three locks. About eight miles farther on it is joined by the Grand Junction Canal; and in eight miles and three quarters more, at Napton, by the Warwick and Napton Canal. Thus far the course is very crooked. In the next two miles it rises fifty-five feet by nine locks to the summit-level, on which it continues ten miles and three quarters (passing a tunnel of 1188 yards) to Claydon. From this the canal descends into the valley of the Charwell, proceeding seven miles and a quarter to Bambury, with a fall of seventy-seven feet by twelve locks. Following the Charwell, and crossing it near Hampton Gay, it passes to its termination in the Thames at Badcock's Garden on the west of the city of Oxford. The total length is about ninety-one miles; and in the last twenty-seven miles and a half from Banbury it falls 118 feet, by eighteen locks. It is twenty-eight feet wide at top, sixteen at bottom, and four and a half deep; but, to act partly as a reservoir, the summit-level is six feet deep. For various improvements and alterations on this navigation, we beg to refer to Priestley's Account of Canals, &c.

The Peak Forest Canal commences at Duckenfield, in the Manchester, Ashton-under-Lyne, and Oldham Canal, and passes south-east fifteen miles to Bugsworth, from which the line is continued seven miles by a railway to Limestone Rock, Peak Forest.

Penclawdd Canal extends eastward from the river Burry at Penclawdd, in Glamorganshire, for three miles and three fifths, to Kingsbridge; and, though short, it is said to be of great utility.

Pocklington Canal, Yorkshire, extends from East Cottingwith, on the Derwent, to Street Bridge, Pocklington, a distance of eight miles and a half.

The Portsmouth and Arundel Canal commences in the tideway in the river Arun, at the village of Ford, three miles from the sea, at Arundel harbour, and proceeds westward close by Yapton, Barnham, and Merston, to half a mile from North Mundham, where the Chichester branch takes off. From this it passes by Donnington to Chichester harbour, where the principal line, which is almost twelve miles long from the Arun, terminates. The bed of the Arun is fifteen feet below high water spring tides; and there is a lock of five feet, above high-water mark, on the bank of the river. A little farther on is another lock of seven feet lift, from which the canal continues on the same level for ten miles five furlongs, to two locks, equal respectively to the two just mentioned, and similarly situated in respect of the other termination in the tideway. This canal is thirty-three feet wide at top, nineteen and a half at bottom, and four and a half deep. Both it and the Chichester branch, of a mile and a quarter, are fed by water raised by a steam-engine. The channel from the extremity of the main line of canal in Chichester harbour, round Thorney Island and Hayling Island, by Thorney and Langstone Wadeways, and Langstone harbour, to the end of the Portsea Canal, is thirteen miles and an eighth. The canal from Eastnay Lake is two miles and three eighths long; there are two locks at the east end, and a basin at the termination at Portsea. This part is five feet deep, and is fed by an engine. From the end of the main line in Chichester Harbour to the canal at Cosham, the distance is fifteen miles and a quarter; and the length of the canal to Porchester Lake in Portsmouth harbour is one mile and a quarter. This branch is seven feet deep, with a sea-lock of ten feet lift at each end. These important undertakings, from their connections with so many other navigations, will tend to open a ready inland communication between this quarter and almost every part of the kingdom, and may become serviceable for conveying military stores from London to Portsmouth in time of war.

Ramsden's (Sir John) Canal, is a short connecting link of three miles and three quarters, between the Huddersfield Canal at the King's Mill near Huddersfield, and the Calder and Hebble Navigation near Cooper's Bridge. It descends fifty-seven feet and a half, by nine locks.

Regent's Canal commences in the Paddington branch of the Grand Junction Canal, near the Harrow Road, and, proceeding in a north-east direction, passes through a short tunnel under the Edgeware Road, and thence runs parallel to Primrose Hill Road, till, having passed on the north of the Zoological Gardens, a branch of half a mile runs south-east to a basin at Cumberland Market. The main line preserves nearly its first direction, till, crossing the Pancras Vale Road, on the north of Camden Town, it turns more eastward; then locking down, it crosses Camden Road and the King's Road, and turns south-east across Maiden Lane, next to Horsfall's Basin, a quarter of a mile beyond which it enters the tunnel under Islington, 900 yards long, but which, most unfortunately, to save a trifle of expense, has no room for a towing-path. It next crosses the New River to Frog Lane, on the east of which is a lock, and also a branch called the basin, passing under the City Road. The main line continues eastward to Bridport Place, and, running parallel with Felton Street, it leaves a second basin on its north bank, and a little farther on a third basin on its south bank. From this it proceeds across Cambridge Heath Road, and then, bending greatly south, crosses Mile End Road, passes to Stepney Lane, crosses the Commercial Road, and finally arrives at the basin at Limehouse, by which it locks into the Thames, being a total distance of eight miles and a half, descending ninety feet by twelve locks besides the tide-lock. At Globe Town, a cut of one mile, running north-east, connects this canal with the River Lea Navigation. It is named the Hertford Union Canal, and sometimes the Lea Union.

Ribble River, Lancashire, has been rendered navigable for eleven miles westward from Penwortham Bridge, near Preston, to its mouth in the Irish Sea.

Rochdale Canal commences in the Bridgewater Canal at Castlefield, Manchester, and about a mile from this is joined by the Manchester, Ashton-under-Line, and Oldham Canal. It then passes the town of Rochdale, and along the north border of the high ground called Blackstone Edge, to its termination in the Calder Navigation at Sowerby Bridge Wharf, a distance of thirty-one miles and a half. The rise from Knott Mill, Manchester, to the summit, is $533\frac{2}{3}$ feet, and the fall from this to Sowerby Bridge is $353\frac{1}{3}$. This canal is one of the main links in the chain of inland navigation between the east and west seas.

The Rother River Navigation commences at Lower Platt, near Midhurst, Sussex, and passes by Cowley Park to Ambersham, and by Petworth and Burton to a little beyond Little Fittleworth, from which a cut passes to the river Arun, near Stopham Bridge, where the navigation terminates, the total length being eleven miles.

The Royal Military Canal commences in the tideway at Shorncliff in Kent, proceeding west to Hythe, and, gradually bending southward, passes on the south of Lympne and Appledore to the junction with the long proposed Weald of Kent Canal. From this it proceeds south to the river Rother, in the bed of which it continues past Rye to Winchelsea, where that river verges south-east, whilst the canal continues due south to Cliff End, and there terminates. The total length is about thirty miles, the width at top is from sixty-two to seventy-two feet, and at bottom from thirty to thirty-six, and the depth is nine feet. The locks are seventy-two feet long and sixteen wide; they are only required for the tide, and the fluctuations of the Rother.

St Columb Canal is a cut of six miles, from Maugan Porth to Lower St Columb Porth, in the county of Cornwall.

The Salisbury and Southampton Canal commences in the Itchin River at Norham, near Southampton, and runs along the north-east shore of Southampton Water to Redbridge, from which the line of navigation is continued north in the Andover Canal. From the latter, at Mitchelmersh, a branch was dug westward to Salisbury, but was abandoned because it would not hold in the water. This had not, it would seem, been thought worth a lining of clay, which, if properly executed, would make any canal hold in.

Sankey Brook Navigation, the first executed in England, originally commenced at Fidler's Ferry, at the mouth of Sankey Brook, from which it at first runs north, gradually bending west, and latterly turns south to St Hellens, where it terminates. The length is about twelve miles, rising seventy-eight feet by ten locks; width forty-eight feet at top, depth five and a half. In 1830 an act was obtained for extending this navigation three miles and a quarter, from a little above Fiddler's Ferry to Widness Wharf, West Bank, near Runcorn Gap.

The Severn River is navigable for 178 miles, with a descent of 225 feet, from Welshpool, through the counties of Montgomery, Salop, Worcester, and Gloucester, till it enters the Bristol Channel. Its navigable connections are the Montgomeryshire Canal at Newtown; the Shrewsbury Canal at Shrewsbury; the Shropshire Canal at the Hay; the Staffordshire and Worcestershire Canal, and the Leominster Canal, at Stourport; the Droitwich Canal at Hawford; the Birmingham and Worcester Canal at Diglis, below Worcester; the river Avon at Tewkesbury; the Coombe Hill Canal at Fletcher's Leap; the Hereford and Gloucester Canal at Gloucester; the Gloucester and Berkeley Canal, both at Gloucester and at Sharpness Point; the Stroud Canal at Framiload; the Lydney Canal below Lydney; the river Wye at Beachley; the Bristol River Avon at Morgan's Pill; and the Monmouthshire Canal at Newport.

Sheffield Canal connects that town with the river Dun Navigation in the township of Tinsley. It is little more than four miles long, with a fall of seventy feet by eleven locks.

The Shrewsbury Canal commences at Rockwardine Wood, in the north extremity of the Shropshire Canal. The first mile is level. At Woombridge it descends seventy-five feet by an inclined plane; and in the next four and three quarters miles to Langdon is a farther fall of seventy-nine feet by locks. It then crosses the river Tern by the first iron aqueduct used in a navigable canal, and, proceeding by Roddington, it passes a tunnel of 970 yards, and at length runs along the bank of the Severn to its termination at Shrewsbury. The total length is about seventeen miles and a half.

Shropshire Canal commences at the Donnington Wood Canal, and passing Rockwardine Wood and Madeley, proceeds to its termination in the Severn at Coalport, two miles below Coalbrook Dale. The length is seven miles and a half. It has a rise of 120 feet, and two falls of 126 and 207 feet, all of them by inclined planes.

Sleaford Navigation extends from Chapel Hill, on the Old Witham River, to the Castle Causeway near Sleaford. It is about thirteen miles and a half long, thirty feet wide at top, eighteen at bottom, and five feet deep. The greater part of its course is embanked through the fens.

Soar River Navigation consists of the river Soar, made navigable for seven miles up from the Trent, and of a cut of one mile and a half, which continues it to Loughborough, where it connects with the Leicester Navigation.

Somersetshire Coal Canal commences at the Kennet and Avon Canal at Limpley Stoke, and terminates at Paulton, a distance of ten miles. It is connected with various collieries by railways.

Staffordshire and Worcestershire Canal commences in the Severn at Stourport, and proceeds northerly by Milton, Kidderminster, Tittenhall, Penkridge, and Baswich, to its termination in the Trent and Mersey Canal near Haywood, Staffordshire. The total length is forty-six miles and a half. In the first twelve miles and a quarter from Stourport, to where it is joined by the Stourbridge Canal, it rises 127½ feet by thirteen locks; in the next eleven miles it rises 166½ feet by eighteen locks. The next ten miles, in which it is joined by the Old Birmingham Canal, are level; and in the remainder it falls 100½ feet by thirteen locks. This canal is thirty feet wide at top, and five deep. The locks are seventy-four feet long, and seven feet wide, but had originally only four feet water on the sills.

Stainforth and Keadby Canal begins in the river Dun, near Stamforth, Yorkshire, and passes eastward fifteen miles to the Trent at Keadby, Lincolnshire, where it has a tide-lock. There is only another lock near Thorne, of five feet lift, the tract is so flat.

Stort River has been made navigable for ten miles in Hertfordshire and Essex, from the New Bridge, Bishop-Stortford, to the river Lea at Rye near Hoddesden.

Stourbridge Canal extends about five miles from the Stafford and Worcester Canal at Stewponey, near Stourton, to the Dudley Canal at Black-Delph, from which a branch of one mile goes to Stourbridge, and another of two miles to Pensnet Chase Reservoir. It rises 191½ feet by twenty locks.

Stour River, between Suffolk and Essex, has been rendered navigable for nineteen miles from Sudbury to Manningtree; thence to Harwich it is a wide estuary.

Stratford-upon-Avon Canal commences at King's Norton, about six miles from Birmingham, and proceeds south-eastward by Lapworth and Preston Mill to Stratford, a distance of twenty-three miles and a half, descending 309 feet. From near Hockley, a branch of two miles and a half goes to Tamworth quarries; from Lapworth another of one mile and three quarters to the Warwick and Birmingham Canal; from Wilmote another of four miles to Temple Grafton Limeworks; and from this branch a cut of one mile to Aston Cantlow.

Stroudwater Navigation commences at Framiload, running eastward across the Gloucester and Berkeley Canal, and the Stroudwater, to Wallbridge, near Stroud, in the Thames and Severn Canal, a distance of eight miles, rising 102½ feet.

Swale River, see Ouse.

Swansea Canal commences in Swansea harbour, and running north-eastward by Landoor, and across the small river Twrch, terminates at Pen Tawe, a distance of seventeen miles, rising 373 feet.

Tamar Manure Navigation. The river Tamar has been made navigable from Morwelham Quay (where Tavistock Canal begins) up to Boat Pool, whence a canal has been continued north-west for about twenty-two miles to Tamerton Bridge. From near Poulson Bridge a branch goes off to Launceton.

Tavistock Canal extends from the tideway in the Tamar four and a half miles north-east to Tavistock, with a rise of 237 feet. From Crebar a branch of two miles goes to the slate quarries at Millhill Bridge, rising nineteen feet and a half.

Tay River is navigable from the city of Perth, gradually widening downwards by Dundee to the German Sea, a distance of twenty-eight miles, through which the tide flows; but it only admits of large vessels reaching Perth at stream tides. It was formerly much obstructed by floods at one season, and shallows at another; but in 1830 an act was obtained for its improvement.

The Tees Navigation commences in that river at Stockton, and proceeds chiefly by an artificial course to Portrack, and thence by the estuary of the Tees Mouth to the German Sea; the total distance is about twelve miles, and level in the tideway.

Thames River having a separate article devoted to it, we shall only here treat very briefly of its navigation and navigable connections. The principal branch of this noble river, under the name of the Isis, and greatly improved by artificial means, begins to be navigable at Lechlade, about 146½ miles above London Bridge by the course of the river, and where the Thames and Severn Canal locks into it. At Oxford it receives the Oxford Canal; at Abingdon, the Wilts and Berks Canal; near Dorchester, its other branch the Thame; at Caversham Bridge, near Reading, the Kennet Navigation; near Woburn Park and Ham, the river Wey, with the Basingstoke Canal; near Brentford, the Grand Junction Canal; a little below Wandsworth, the Kensington Canal. Pursuing its course through London, it comes to the St Katherine's Docks, and then to the London Docks, a little below which it is passed underneath by a tunnel. It is next joined on the south by the Grand Surrey Canal, and then at Limehouse on the north by the Regent's Canal, and the Limehouse Cut to the river Lea. Proceeding a little, it reaches the western entrance to the West India Docks at the Isle of Dogs, round which it makes a more than semicircular bend, first south to Deptford and Greenwich, and then north again to the eastern or Blackwall entrance to the West India Docks. To avoid or shorten this route, a cut, called the City Canal, was made by government across the isthmus, and after all cutting off little more than half the bend; but so few inclined to avail themselves of such a partial improvement, that this canal was quite neglected, and was latterly sold to the West India Dock Company, who now use it for the wood trade, under the name of South Dock. But before reaching Deptford, the Thames had on its western bank passed the Commercial Docks. At Blackwall it passes the East India Docks, and, at Bow Creek receiving the river Lea, pursues its way to Woolwich, where a short canal is cut to the Arsenal, a little below which it receives the river Roding on the north, and, nearly opposite Purfleet, the river Darent on the south. At Gravesend, the Thames and Medway Canal unites with it; at Sheerness on the south it receives the river Medway, and has now itself become a large estuary, five miles wide, called the Mouth of the Thames, which, expanding greatly, receives from the north and west the rivers Crouch, Blackwater, and Colne.

Owing to the natural obstructions which exist in many parts of the river, from bends, shoals, islands, weeds, &c. the velocity of the Thames does not follow the law of the variation of the inclinations; and the artificial obstacles from weirs, pound-locks, fishing-aytes, &c. render it impossible to ascertain the velocity correctly. Much depends also on the volume of water which may be passing down the river at the time, and the use of *flashes*.[1] The total fall from Lechlade to low-water mark at London Bridge, a distance of 146½ miles, is 258 feet; being on an average about twenty-one inches per mile. This is overcome by several locks, constructed at different periods, of which the lowest, at Teddington, eighteen miles and three quarters above London Bridge, forms the limit of the tide. In general the velocity may be estimated at from half a mile to two miles and three quarters per hour; but the mean may be about two miles. Between London Bridge and Westminster Bridge the mean velocity of the flood tide is now three miles per hour, maximum three and a half; and the mean ebb three miles and one sixth, maximum three and

[1] A flash is water suddenly let out to increase the depth over a shallow while a boat is passing. It also helps to scour and deepen the channel.

three quarters. Formerly they were much less. The fall from Teddington Lock to London Bridge is only sixteen feet and three quarters, or ten inches and three quarters, per mile; for in general the fall gradually diminishes from Lechlade downwards.

The removal of the numerous and bulky piers of the Old London Bridge has wrought an important change in the Thames, not only above or west of the bridge, but likewise, though in a smaller degrec, below or east of it. The very contracted spaces through which the water had formerly to force its way occasioned frequently a fall of five feet at low water, instead of which there is now only a fall of about two inches at the new bridge; so that the low-water line above the bridge is nearly five feet lower at spring tides than formerly. In consequence of this, a greatly increased body of tidal water now flows up and down the river, and with a decidedly greater velocity than formerly. The effect of this is to scour and deepen the bed of the river; its influence in this respect being already sensibly felt as far up as Putney Bridge, seven miles and a half above London Bridge. The shores above the latter, that were formerly foul and muddy, are now becoming clean shingle and gravel; and near low water the beach is quite hard and firm. East of London Bridge the shoals are also deepening; and there can be little doubt that the change will at no distant period be felt from the Nore up to Teddington. The depression of low water below the bridge has been so considerable as to cause ships in many instances to ground in their tiers. From a register of the tides, it appears that the average depth at low water on the sill at Shadwell Dock is twenty-two inches below the old mark called Trinity Datum; and where formerly there were eight feet upon the dock sill there are now only six feet two inches on the average. Before the removal of the old bridge, a barge starting from the Pool at Rotherhithe with the first of the flood, could not get farther than Putney Bridge without the assistance of oars or horses. But, under similar circumstances, a barge now reaches Mortlake, four miles farther up, before using oars; and with a little help she may reach Richmond, and, taking horses there, get to Teddington in a tide. The descent down the river has been equally facilitated.

The immense trade of the navigable part of this river arises principally from its having London on its banks, and bearing to and from it numberless ships, fraught with the produce of every country and every climate. Its depth of water is so great, that even at ebb tide it is from twelve to thirteen feet in the fair way of the river above Greenwich. The mean range of the tides at London Bridge is about seventeen feet, whilst at extreme springs it is about twenty-two. Up to Deptford, the river is navigable for ships of any burthen; to Blackwall, for those of 1400 tons; and to the St Katherine's Docks, adjoining the Tower, for vessels of 800 tons.

The Thames and Medway Canal is a cut of about seven miles and a half through the isthmus, or rib of land, between these rivers, and was constructed for the purpose of shortening by forty miles (some say forty-seven) the water communication between Gravesend and Chatham, or Rochester, which had hitherto been by the Nore. It commences in the south bank of the Thames, at Gravesend, nearly opposite Tilbury Fort, where it has a great tide-lock, and a basin and wharfs. From this it runs eastward for about three miles through Gravesend Marshes; then, after turning considerably to the south, it passes through a tunnel of two miles and a half, and proceeds to join the river Medway, where it has another tide-lock and basin nearly opposite to Chatham. The water in this canal is fifty feet wide at top, twenty-eight at bottom, and eight feet deep. The hill through which the tunnel is carried is in some places of such a loose texture that several of the workmen were killed by the unexpected shooting in of the chalk and flints upon them. They had not, it seems, used any precaution to prevent such an occurrence, or to avoid the danger of it. This tunnel, being of large dimensions, and provided with an excellent towing path, has greatly the advantage of many of the miserably confined holes which are carried through hills in other parts of the kingdom. The breadth of the water through the tunnel is twenty-two feet; but a particular description of the locks will be found farther on.

The Thames and Severn Canal commences at the extremity of the Thames and Isis Navigation, near Lechlade, and proceeds by Kempsford and Cricklade to Latton, where it is joined by the Wilts and Berks Canal; thence it passes to Siddington St Mary, at which a branch of a mile goes to Cirencester; continuing westward, it passes through the famous Sapperton tunnel, 4300 yards long, and 250 feet under the top of the hill. From this, it passes to its termination in the Stroudwater Canal, at Wallbridge, near Stroud. The total length is thirty miles and one eighth, viz. from Lechdale to the tunnel twenty miles and three eighths, rising 134 feet by fourteen locks; the tunnel or summit-level two miles and three eighths, and from it to the termination seven miles and three eighths, falling 243 feet by twenty-eight locks. This canal is forty-two feet wide at top, twenty-eight at bottom, and five deep. The locks are eighty feet long and twelve wide.

The Tone and Parrett Navigation commences in the line of the proposed Grand Western Canal at Taunton, and runs nearly north by a bending course, passing Bridgewater, to Start Point, in the Bristol Channel; being, however, joined in its course at Borough Chapel by the Parrett River. The length is about twenty-seven miles.

Trent River begins to be navigable at Burton-upon-Trent, where it is joined by a branch from the Grand Trunk, and which is about 117 miles from the Humber. It proceeds in a north-easterly direction to near Swarkestone, where it receives the Derby Canal, and then at Wilden Ferry it is joined by the Grand Trunk or Trent and Mersey Canal; next by the river Soar or Loughborough Navigation, and opposite to it by the Erewash Canal; then passing Clifton Hall, where the Beeston Cut, which connects with the Nottingham Canal, joins it on the north, it runs down to Nottingham, and there joins the Grantham Canal. Next at Torksey it connects with the Foss-dike Navigation, and at West Stockwith with the Chesterfield Canal and the river Idle. At Keadby it connects with the Stainforth and Keadby Canal, and joining the river Ouse at Trentfalls, their united waters form the Humber. The total descent in the 117 miles is about 118 feet. This river, connecting the port of Hull with a wide extent of country, by numerous rivers and canals, forms a ready medium of traffic for the several very extensive manufacturing and agricultural districts with which it communicates.

The Trent and Mersey Canal, sometimes called the Grand Trunk, from its passing through the central parts of the kingdom and connecting the Trent, Mersey, and Severn, commences at Wilden Ferry, where the Derwent falls into the Trent, and running south-west, passes Aston and Swarkestone, near where it is crossed by the Derby Canal; thence continuing to Burton, where it communicates with the Trent, it passes on to Tradley, and there joins the Coventry and Fazeley Canal. Turning north-west by Rugeley to Heywood Mill, it is there joined by the Staffordshire and Worcestershire Canal. Passing by Weston to Stone, and north by Trentham to Stoke, it is there joined by the Newcastle-under-Line Canal on the south; and the Caldon branch runs from its north side to near Uttoxeter. Continuing north by Etruria, it passes through the new tunnel of 2880 yards at Harecastle, in Staffordshire, which was made only about a dozen years ago, the original tunnel being excessively confined, and without a towing-path. This canal is then joined by the Macclesfield Canal. It next inclines north-west to Middlewich, where the Middlewich branch goes off; then passes near Northwich, and through the three small tunnels of Barnton, Saltersford, and Preston, to its termination at Preston Brook, in the Duke of Bridgewater's Canal. From Wilden Ferry on the Trent, to the Harecastle summit, there is a rise of 316 feet; and from this to Middlewich the fall is 326 feet; the remainder being level to Preston Brook. The total length is about ninety-three miles.

Tyne River is navigable for large vessels in the tideway for fifteen miles up from its mouth, in the German Sea, to Newcastle, and a few miles farther for a particular kind of barges called *keels*. The principal trade is in coals, and has for ages been carried on to a great extent.

Ulverstone Ship Canal commences at Hammerside, in Morecombe Bay, in the Irish Sea, and terminates at the new basin and wharfs at Ulverstone; it is about a mile and a half long. The water is sixty-five feet wide at top, thirty at bottom, and fifteen feet deep. It has a tide-lock 112 feet long at its entrance.

Ure River Navigation, or Ripon Canal, proceeds partly up the Ure, from its mouth at Milby, on the Ouse or Yore River, and partly by a canal to Ripon. The length is about eight miles and a half.

The Warwick and Birmingham Canal commences in the Warwick and Napton Canal at Saltesford, in the borough of Warwick, and passing north-west by Bowington to Kingswood, is there joined by the Lapworth branch of the Stratford-upon-Avon Canal; thence, by Knowle, Olton End, and Kingsford, it at length joins the Digbeth branch of the Birmingham Canal at Birmingham. The first half mile is level; the next two and a half to Hatton rise 146 feet by twenty locks; and thence there is a level of eight miles and a half to Knowle Common. Having in the next quarter of a mile risen forty-two feet by seven locks, it then runs ten miles level, and the remainder falls forty-two feet by five locks. The total length is twenty-two miles and a half.

Warwick and Napton Canal extends from the Warwick and Birmingham Canal at Saltesford to the Oxford Canal, near Napton-on-the-Hill, a distance of about fourteen miles, with a rise of 134 feet.

Waveney River, between Suffolk and Norfolk, is navigable for about twenty-three miles from its mouth in the Yore, at Burgh, up to Bungay.

Wear River is navigable from its mouth in the German Sea, at Sunderland, up to near the city of Durham; a distance of about eighteen miles. This navigation is of great importance for the exportation of coal, which abounds in the neighbourhood; and in 1830 an act was obtained for various improvements on it.

Weaver River Navigation commences in the tideway of the Mersey at Weston Point, and proceeds first in a cut for four miles, and then nearly up the course of the river to Winsford Bridge; a total distance of twenty-three miles and three quarters, ascending fifty feet by twelve locks.

Welland River has, by means of locks, weirs, and cuts, been made navigable from its mouth in the Wash, up to Stamford, in Lincolnshire; but the works require to be greatly improved.

Wey River has been rendered navigable from its mouth in the Thames, partly by extensive side-cuts, and partly in the bed of the river, up by Woburn Park and Guildford to Godalming. In fifteen miles and a quarter from the Thames to Guildford it rises sixty-eight feet and a half; and thence to Godalming, which is mostly an artificial canal, the rise is thirty-two feet and a half. The total length is about twenty miles and a half. About two miles from the Thames it is joined by the Basingstoke Canal, and farther on by the following.

The Wey and Arun Junction Canal extends from the Wey, near Shalford Powder Mills, to the Arun Navigation at Newbridge; a distance of eighteen miles. It forms part of the navigable line between London and Portsmouth.

The Wilts and Berks Canal commences at Semington, in the Kennet and Avon Canal, and proceeds by near Melksham, Chippenham, Wootton-Basset, and Wantage, to the Thames at Abingdon; a distance of fifty-two miles. From Derry Hill a branch of one mile and a half goes off to Chippenham; and near Stanley House another of three miles goes to Calne. From near Eastcott a branch of eight miles and a half, originally called the North Wilts Canal, goes to join the Thames and Severn Canal, near Cricklade, with a fall of fifty-eight feet and two thirds; and from Breach Field a branch of three quarters of a mile goes to Wantage. In the first seven miles and three eighths to the Chippenham branch the rise is fifty-four feet; thence to the Calne branch, one mile and a half, rising seventeen feet; and thence to the summit-level, ten miles and three quarters, rising 130 feet. The summit extends nine miles and three eighths, and in fifteen miles from it to Wantage River the fall is seventy-one feet and a half; thence to Abingdon, seven miles and three quarters, the fall is ninety-six feet and a half. This canal is an important link in several navigations.

The Wisbeach Canal is a level cut of six miles, from the Nen River at Wisbeach, to the Old River at Outwell, at the end of Well Creek, through which it communicates with the Ouse at Salter's Load Sluice.

Witham River is navigable from its mouth in the Wash, up to the Foss-dike Navigation, at the city of Lincoln; a distance of thirty-eight miles, through a level country, viz. from the sea to Boston five miles, thence to the Sleaford Canal eleven miles, thence to the Horncastle Navigation three miles, and thence to Lincoln nineteen miles. The greater part is embanked on both sides from the sea upwards.

The Worcester and Birmingham Canal commences at the junction of the Birmingham Canal and the Birmingham and Fazeley Canal, at the upper end of the town of Birmingham, and runs south-west to its junction with the Dudley Canal at Selly Oak; thence south-east to King's Norton, where it receives the Stratford-upon-Avon Canal. From this it continues south-west by Stoke Prior, till, a little east of Droitwich, it joins the Severn at Diglis, a little below Worcester. The total length is twenty-nine miles, the breadth at top forty-two feet, and the depth six. In the first fourteen miles the canal is level; but in the remaining fifteen it falls 428 feet by seventy-one locks, which are each eighty-one feet long and fifteen wide. There are five tunnels on this line; that at West Heath is 2700 yards long.

Wreak and Eye Rivers, or Leicester and Melton-Mowbray Navigation, extends from the Leicester Navigation at Turnwater Meadow to the Oakham Canal at Melton-Mowbray, about eleven miles. It follows the courses of the Wreak and Eye.

Wye and Lugg Rivers, the former the principal branch, begins to be navigable ninety-nine miles and a half by water from the Severn, viz. from Hay to Hereford thirty miles, thence to the mouth of the Lugg seven and a half, thence to the town of Ross twenty-one and a half, thence to Lidbrook eight, thence to Monmouth twelve, and thence to the Severn twenty and a half. This river has a considerable declivity; and the great rise of the tides renders the lower part difficult and dangerous.

Wyrley and Essington Canal commences near Wolverhampton, in the Birmingham Canal, and passes by Polsal and Lichfield to the Coventry Canal near Huddlesford, a distance of twenty-four miles. The first sixteen to Cannock Heath Reservoir are level; in the remaining eight is a fall of 270 feet by thirty locks. There is a branch of five miles and a half to Hay-Head Lime-works; another of two miles and a half to Lords-Hay Collieries; another of four miles to Wyrley-Bank Collieries, with a cut of one mile from it to Essington New Collieries. The canal is twenty-eight feet wide at top, sixteen at bottom, and four and a half deep.

Yare River is navigable from Norwich to Yarmouth by a crooked course of twenty-eight miles. At Yarmouth it is joined by the river Thyrn, and at Burgh by the Waveney. This navigation being incommoded by shallows, gave rise to the Norwich and Lowestoff Navigation.

Yore River, see Ure.

Several of the British canals always were, and others are now become, very unproductive. Some have suffered from an ill-advised location, and others have been reduced in value by changes in the course of trade. The rapid progress of manufactures, and the increase of domestic commerce, have invited a resort to new and shorter channels of communication; and not a few costly works are now sustaining an unequal competition with the less expensive productions of more modern art. The day may not be very distant when these will in their turn become unprofitable, and give place to other projects; but they can never cease to be regarded as monuments of skill in mechanical construction. Some of the canals of England are sadly cramped, by the miserably confined state of their bridges, and especially of their tunnels, which are often so low and narrow as to have neither room for a towing-path, nor yet for the boatmen, except lying prostrate, and moving the boat slowly along, by pawing against the walls with their hands or feet. Some excuse might be pleaded for those of this sort which were first made, or which are in obscure districts; but it is remarkable that the tunnel of the Regent's Canal, which passes under a wing of the great metropolis, and was only made in 1819, should have no towing-path.

Ireland.

It has been said that the unfortunate Earl of Strafford, from having seen the utility of inland navigation in the Low Countries, first suggested the improvement of river navigation in Ireland. In 1703 the first act of parliament was passed for rendering the Shannon navigable, and many improvements were projected. Nothing, however, was effected but an useless expenditure of L.140,000 on the Shannon and Boyne in the year 1758. Various other large sums were afterwards granted and frittered away in partial improvements of the Shannon, Boyne, Barrow, and Newry Rivers, besides the Grand, Royal, Kildare, Naas, and Lough Earne Navigations.

The following is a concise account of the principal inland navigations of Ireland, arranged alphabetically; but several others are in progress.

Bandon River, county Cork, is navigable from the port of Kinsale up to within two miles of Bandon.

Bann River, county Down, is navigable for nine miles, from where it is joined by the Newry Canal, near Portadown, to its entrance into Lough Neagh. This is sometimes called the Upper Bann. The outlet of Lough Neagh, called the Lower Bann, is not navigable, but might surely be easily made so, since it has only a descent of thirty-eight feet to the sea, five miles below Coleraine.

Barrow River has been rendered navigable from the tideway below St Mallins, up to where it is joined by the Grand Canal at Athy Bridge, a distance of forty-three miles, falling 172 feet. But from Athy to the mouth of the Barrow, in the estuary of Waterford harbour, and through that to St George's Channel, the distance exceeds sixty miles.

Blackwater River, county Cork, is navigable from its mouth at Youghall, up as far as the tide reaches, or at most to Cappoquin. There is another and smaller Blackwater, connected with the Tyrone Canal, and flowing into Lough Neagh.

Boyne River is navigable from the bay of Drogheda for twenty-two miles up to Trim, in the last seven miles of which it ascends from Navan 189 feet, by means of locks, which are from eighty to 100 feet long, and fifteen wide.

Corrib River and Lough or Lake form a navigable line, commencing at the mouth of that river in Galway Bay, and extending from Galway town in a north-westerly direction for about twenty-four miles.

Earne River and Lough or Lake are navigable through the lake, from the upper part, where the river enters it, below Belturbet, till it leaves it again at Enniskillen, where it is obstructed by weirs; but below the isle on which that town is built the river again expands into the lower part of the lake, through which it is also navigable. Thus far the entire distance is about thirty miles, and the navigation is terminated by a fall, from which the river has a rapid course of nine miles to Donegal Bay. It has been proposed to construct a canal from Lough Earne, beginning near Belturbet, and to follow along the valleys of the Finn and Blackwater to Lough Neagh.

Fergus River, county Clare, is navigable from its mouth, in the Shannon, up to Ennis, the county town.

Foyle River is navigable for ten miles from its mouth, in the estuary of Lough Foyle, below Londonderry, up to Strabane.

The Grand Canal commences on the south side of the river Liffey, near its mouth, and proceeds westward by the south side of the city of Dublin, through the counties of Dublin, Kildare, and King's County to the Shannon, with which it unites near Banagher. But, exclusive of this main line of about eighty-seven miles, there is a westerly branch or rather continuation of the line for fourteen miles beyond the Shannon to Ballinasloe, and there is a southerly branch of twenty-six miles from Lawton to Athy, where it joins the Barrow. There are also branches to Naas, Mount Mellick, Portarlington, and other places. The water is forty feet wide at the surface, twenty-five at the bottom, and six deep. The locks on the main line are seventy feet long, fourteen and a half wide, with five feet of water on the sill, and their average lift is nine feet. The track of this canal passing for a considerable way through the bog of Allen added greatly to the expense, which is said to have exceeded two millions sterling. The highest part rises 278 feet above the sea.

Lagan Navigation commences in the tideway at Belfast, and proceeds mostly by the course of the river as far as Lisburn, from which it is continued by a canal, by Hillsborough and Moira, to Lough Neagh. The total length is twenty-eight miles.

Lee River is navigable in the tideway up to the city of Cork, and for small craft somewhat farther. Below Cork, however, the navigation is principally an arm of the sea called Cork harbour.

Liffey River is navigable from its mouth in Dublin Bay for about three miles up to Carlisle Bridge, at the farther end of the city of Dublin. From the south side of this navigable part proceeds the Grand Canal, and from the north side the Royal Canal.

Limerick Navigation commences at that city, and proceeds in a north-easterly direction, partly in the Shannon and partly by canals, for fifteen miles, to Killaloe, at the south end of Lough Derg.

Maig River, county Limerick, is navigable from its mouth in the Shannon to near Adare.

Moy River, county Mayo, is navigable for about five miles, from Killala Bay up to Ballina.

Navigation, Inland.

Neagh Lough or Lake, being about twenty miles long and ten broad, is generally of sufficient depth to be navigable to a considerable extent in every direction. It communicates with Belfast by the Lagan Navigation, with the Tyrone Collieries by the Blackwater, with Antrim by the Antrim River, and southward with the sea by the Newry Navigation.

Newry Navigation commences in the tideway of Lough Fathom, three miles below Newry, which it passes, and proceeds sixteen miles by a canal to the upper Bann River, in which it continues to Lough Neagh. The entire length is about thirty miles and three eighths, generally in a north direction. It has hitherto been a very imperfect navigation, but was the first executed in Ireland.

Nore River is navigable from its mouth, in the Barrow, two miles above New Ross, for considerable vessels to Inistioge, and up to Thomastown for barges.

The Royal Canal commences at Dublin, on the north side of the Liffey, and proceeds in a direction which generally diverges slightly from that of the Grand Canal, being about west by north for eighty-three miles to its junction with the Shannon at Tarmonbury. The water is forty-four feet wide at top, twenty-four at bottom, and six deep, and the summit is 322 feet above the sea. The locks are eighty-one feet long and fourteen wide. A few years ago this canal was said to be in a sadly neglected state; part of it at Leikslip, eight miles only from Dublin, having scarcely ever been used, and the works apparently fast going to ruin.[1]

Shannon River forms the most important feature in the inland navigation of Ireland. For the first 144 miles of this navigation, viz. from the head of Lough Allen to the sea below Limerick, the Shannon may be considered as a concatenation of rivers and lakes. Issuing from Lough Allen, it passes Leitrim, Carrick, Tarmonbury, &c., and then enters, at Lanesborough, a very irregularly shaped and extensive sheet of water, called Lough Ree, about seventeen miles in length. Leaving it, the river, now greatly augmented, passes Athlone, and then winds by Shannon Bridge and Banagher to Portumna, near which it expands into Lough Derg, another narrow lake, twenty-three miles long, with deep bays and inlets. From the southern extremity of this lake it flows on to Limerick. In this extent of navigation we have, first, Lough Allen, ten miles; thence to Lough Ree, forty-three; Lough Ree itself, seventeen; thence to Lough Derg, thirty-six; Lough Derg, twenty-three; thence to Limerick, fifteen; making together 144 miles. The mean height of Lough Allen above the sea at Limerick is about $143\frac{1}{2}$ feet, being on an average about a foot of declivity per mile. Instead of the natural fall, however, the water has been reduced, by means of locks, to a series of level pools. The estuary or frith of the Shannon extends south-west about seventy miles beyond Limerick to its mouth, which is finally about eight miles wide between Loop Head and Kerry Head, at the Atlantic.

The direction of the Shannon from Lough Allen to Limerick, though generally south by south-west, is very circuitous, and broken by many streams, islands, and rocks. The soundings are as various, and both banks are liable to be overflowed by the river to a great extent; and the large expanse of the lakes would require a different sort of vessels from those which navigate the river. The works which have been constructed to overcome the natural difficulties of the navigation are either insufficient or in a state of decay; and it seems to be generally admitted that very little real good can be effected until the natural obstructions are removed, the number of lakes reduced, and the channel deepened and improved in various parts; though it is still doubted if the navigation would even then be suitable for any thing but steam-vessels. The Shannon connects with the Royal Canal at Tarmonbury, and with the Grand Canal at Shannon harbour, near Banagher. At Shannon Bridge it receives, on the west, its principal tributary the Suck; on the east, the Inny, the Upper and Lower Brosna, Mulkerna, Maig, Fergus, &c. Much information on this and the other navigations of Ireland will be found in the Parliamentary Reports, particularly those for 1830 and 1834.

Slane or Slaney River is navigable from its mouth in Wexford Haven, for fourteen miles, to Enniscorthy.

Suir or Sure River unites with the Barrow in the estuary called Waterford harbour, about five miles below the town, and is navigable from that up to Carrick for sloops, and to Clonmell for barges. At the town of Waterford, the largest ships lie afloat in forty feet water.

The Tyrone Colliery Canal commences at the south-west extremity of Lough Neagh, proceeding by a short cut across the isthmus of Maghery to the Blackwater River, and, following it a short way, passes by another cut of three miles to the Colliery Basin, from which a railway extends to the mines.

NORTH AMERICA.

United States.

General observations.

The advantages resulting to the United States from their separation from the mother country, and the great and rapid improvement which has taken place in the condition and circumstances of that republic since the American revolution, are in nothing more strikingly displayed than in the increased facilities of travelling and intercourse between the different parts of the Union, produced by the construction of roads, canals, and railways, and by the improvement of river navigation. But the spirit of enterprise with respect to internal improvement has been chiefly manifested, and has extended more or less to all the states of the Union, since the close of their last war with Britain. For although it is a considerable time since something was first done towards inland navigation in the United States, yet till then comparatively little attention was paid to this by the Americans. Indeed, as long as they were cramped by the narrow policy of the parent country, they had little inducement to undertake any thing of the sort; and from the peace of 1783 till the adoption of the present constitution they had not the means; besides, their peculiar situation and employment during the long wars in Europe rendered internal improvements of this kind less necessary. The experience of the last war between Britain and the United States, and the long peace which succeeded it in Europe, together with the vast expansion of American population, have shown the importance and necessity of such works, as well as others, in that extensive country; and, since the year 1815, the United States have progressed in these improvements with an unexampled rapidity. Most of the canals on the continent of Europe have been constructed at the expense of governments; in England chiefly at the expense of companies or individuals; and in the United States they have been made by the states and by individuals, aided occasionally by the general government. In locating canals in this latter country, two principal objects have been kept in view; one to insure a safe inland communication along the Atlantic border in case of a war with any power possessing a superior maritime force; whilst another and very important object

[1] Macculloch's Statistics of the British Empire.

has been to connect the waters of the western districts with those of the eastern, and thereby facilitate the intercourse between these two distant sections of the country. The vast expansion of population in the western parts, and the great and growing resources of that portion of the Union, have rendered such improvements of great importance, and have created rival interests in the eastern, in order to secure the advantages of this intercourse. The valley of the Mississippi is watered by rivers, some of which, only of the third rate, extend 1000 miles; and it is also indented by lakes the magnitude of which justly entitles them to the appellation of inland seas. Its population is spread over a country unrivalled in the extent and magnitude of its navigable waters, as well as in the fertility of its soil. The navigation of these great rivers, as well as that of many others, which was formerly very difficult, against the stream, has been wonderfully facilitated by the application of steam power, which has enabled the navigator to propel his vessel up the river, and to triumph over the violence of the torrent; and thus the rivers by which great continents are intersected have been rendered doubly valuable in facilitating the inland communications of the country, and in laying open the most remote and formerly sequestered scenes to the inquisitive researches of travellers. With respect to canals, there is no navigable line entirely artificial (for those of China are partly rivers) of such length as the Erie Canal, which is 363 miles, and was formed in about eight years. That of Languedoc, in France, is only 148 miles, and occupied fourteen years in construction, even during the reign of Louis XIV. However, the great canal of Amsterdam, in Holland, though only fifty miles long, contains twice as much water as the Erie Canal.

The aggregate length of canals now finished in the United States exceeds 2000 miles; but some of the states do not admit of their construction, except to a comparatively small extent, whilst others present a vast field and great inducements for prosecuting such works on a magnificent scale. Our limits, however, will only admit of a very brief description of these improvements; and to this we shall now proceed, following the order in which the states are usually arranged, and omitting of course such of them as are not possessed of canals.

Maine.

The Cumberland and Oxford Canal, twenty miles and a half long, extends from the tideway near Portland to Sebago Pond. It has twenty-six locks, and was completed in 1829. By means of a lock in Songo River, the navigation is continued into Brandy and Long Ponds, making in all fifty miles. Improvements have been projected in the navigation of the river St Croix and the adjacent waters. It has also been proposed to construct a canal from the mouth of the Sebasticook River, near Waterville, on the Kennebeck, to Moosehead Lake.

New Hampshire.

Several canals have been constructed around falls in the Merrimack. Bow Canal, one third of a mile in length, three miles below Concord, with four locks, passes a fall of twenty-five feet. Hooksett Canal, fifty rods long, with three locks and a lockage of sixteen feet, passes Hooksett Falls. Amoskeag Canal, with nine locks and a lockage of forty-five feet, passes Amoskeag Falls, nine miles below Hooksett Falls. Union Canal, immediately below Amoskeag, overcomes seven falls in the river, and has seven locks in nine miles. A canal is now in progress around Sewall's Falls, in Concord.

Massachusetts.

The Middlesex Canal, connecting Boston harbour with the Merrimack at Chelmsford, two miles below Lowell, opens a water communication between Boston and the central parts of New Hampshire, and is twenty-seven miles in length. It has twenty locks, with a lockage of thirty-six feet; and is thirty feet wide at top, twenty at bottom, and three feet deep. It was completed in 1808, and was then the largest in the United States.

Blackstone Canal, extending from Worcester to Providence, in Rhode Island, is forty-five miles long.

The Hampshire and Hampden Canal, extending from the boundary of Connecticut in Suffield, to Northampton, is twenty-two miles long, and, forming a continuation of Farmington Canal, which is fifty-four miles in length, makes the whole line from Newhaven to Northampton seventy-six miles.

Montague Canal, for passing the falls in the town of that name, is three miles in length; and South Hadley Canal, around falls in the town of South Hadley, is two miles in length.

Connecticut.

Farmington Canal, fifty-four miles long, commences at Newhaven, passes through the valley of Farmington River, and at the boundary of the state of Massachusetts it unites with the Hampshire and Hampden Canal, which reaches to Northampton, and is twenty-two miles in length. Enfield Canal, five miles and a half long, is constructed around the Enfield Falls in Connecticut River.

New York.

The Erie Canal, extending from Albany on the Hudson River to Buffalo on Lake Erie, a total distance of 363 miles, is one of the greatest and most important works of the kind in the world. It was projected by an American patriot, Mr De Witt Clinton; commenced in 1817, and finished in 1825. The water is forty feet wide at the surface, twenty-eight at the bottom, and four feet deep. These are generally the dimensions of the other canals in this state, and therefore they cannot carry very heavy boats; but a less depth will always suffice if the boats are not encumbered with keels, which are utterly useless in a canal. The western section, from Buffalo on Lake Erie to Montezuma on Seneca River, is 157 miles in length, with twenty-one locks for a fall of 186 feet; the middle section, from Montezuma to Utica, is ninety-six miles, with eleven locks for a rise and fall of ninety-five feet; the eastern section, from Utica to Albany, is 110 miles, with fifty-two locks for a fall of 417 feet; total length 363 miles, with eighty-four locks for a total rise and fall of 698 feet. Lake Erie is 565 feet above the Hudson River at Albany. The average rise or fall of eighty-one of the locks is eight feet and a half, the other three are regulating or guard-locks.

This canal forms a channel by which the trade of the great inland waters of Lake Erie, Lake Huron, Lake Michigan, &c. may find access to markets in the populous cities of Eastern America and of Europe. Indeed there is already such a traffic on this canal and its branches, described below, that it has been proposed greatly to increase its dimensions, which must require many times the additional expense necessary to have made it sufficiently large at first. There is, however, nothing very remarkable in this, because the most proper size of a canal can seldom be foreseen by the projectors.

Champlain Canal, sixty-three miles long, commences, at its junction with the Erie Canal, nine miles north of Albany, and terminates at Whitehall, on Lake Champlain, in Washington county, thus connecting the Erie Canal and the Hudson River with Lake Champlain. It has seven locks for a rise of fifty-four feet from the lake to the summit-level, and fourteen locks for a fall of 134 feet from this to the Hudson, in all twenty-one locks; the rise and fall are 188 feet. It has a lateral cut connecting it with the Hudson by three locks at Waterford, eleven miles north of Albany, similar to the cut connecting the Erie Canal with the same river at West Troy by two locks.

The Oswego Canal, of thirty-eight miles, from Salina to Oswego, connects Lake Ontario with the Erie Canal. Half the distance is canal and half slack-water or river navigation. It has fourteen locks, thirteen of stone and one of wood and stone, for a fall of 123 feet from Salina to Lake Ontario.

Navigation, Inland.

The Cayuga and Seneca Canal commences at the Erie Canal at Montezuma, Cayuga county, and terminates at Geneva, Ontario county, connecting the Erie Canal with Seneca Lake. It has also a lateral branch to East Cayuga village on the Cayuga Lake, being thus connected with that lake. It opens altogether a lake navigation of more than a hundred miles. The length is twenty miles and forty-four chains from Geneva, on the Seneca Lake, to Montezuma on the Erie Canal. It is half canal and half slack-water navigation, and has eleven wooden locks for a fall of seventy-three feet from Seneca Lake to the Erie Canàl at Montezuma.

The Chemung Canal extends from the head of the waters of Seneca Lake to Chemung (or Uioga) River, a branch of the Susquehannah, at the village of Elmira, Tioga county. The length is twenty-two miles and a half, with a navigable feeder of thirteen miles and a half from Painted Post, Stuben county, on the Chemung River, to the summit-level; total, thirty-six miles. This canal connects the Erie Canal with the Susquehannah River. It has fifty-two wooden locks, with 516 feet of lockage, and one guard-lock.

The Crooked Lake Canal extends from Penn Yan to Dresden, both in Yates county, connecting the Crooked and Seneca Lakes. It is eight miles long, and has 260 feet of lockage, with twenty-seven wooden locks, and one guard-lock.

The Chenago Canal extends from Utica to Binghamp, a distance of ninety-seven miles, with 109 locks. It has sixteen miles of navigable feeders.

The Delaware and Hudson Canal extends from the Hudson River at Kingston, to Port Jervis on the Delaware, fifty-nine miles; thence up the Delaware to the mouth of the Lackawaxen River, twenty-four miles; thence in Pennsylvania to Honesdale, twenty-six miles; total, 109 miles. From Honesdale a railway of sixteen miles and a half, with five inclined planes, rising 800 feet, extends to the coal mines at Carbondale on the Lackawana.

Haerlam Canal, of three miles, intended to connect the Hudson and East Rivers, is begun, but not completed. Chittenango Canal, connecting that place with the Erie Canal, is one mile and a half long, with four locks. Sodus Canal, intended to connect Seneca River with Great Sodus Bay on Lake Ontario, was projected in 1829, and will be twenty-five miles long. Scottsville Canal, intended to connect the Genesee River with Scottsville, in Monroe county, was projected in 1829. The Oneida Lake Canal, of eight miles and a half, intended to connect Oneida Lake with the Erie Canal, was put under contract in 1833. Auburn and Oswasco Canal, intended to connect Auburn with Oswasco Lake, was projected in 1832, and is to be three miles in length.

It has been proposed to connect by railways or canals the Erie Canal, somewhere about Rome or Herkinner, with the waters flowing into the St Lawrence at Ogdensburg.

The Genesee and Alleghany Canal. The projectors of the Erie Canal contemplated its connection with the river Ohio, by a south-west branch, uniting with the river Alleghany at Olean, in Cattaraugus county. A report of a survey of the line was made to the legislature in 1829. The length from Rochester along the valley of the Genesee to Olean, including navigable feeders, is to be 107 miles, which, with a side-cut to Danville of fifteen miles and a half, make the total length 122½ miles, with 1057 feet of lockage.

The Black River Canal is proposed to extend from the Erie Canal at Rome to the foot of High Falls on Black River, a distance of about thirty-five miles, with improvements in the navigation of Black River from the High Falls to Carthage, a farther distance of forty miles.

A steam-boat canal from Lake Ontario to the Hudson has been proposed, extending from Oswego to Utica, and thence along the Mohawk to the Hudson. A steam-boat or a ship canal has likewise been proposed around the Falls of the Niagara. The longest proposed route would be fifteen miles, with a lockage of 320 feet; a second route would be nine miles, with the same lockage; and a third only seven miles and a half. A ship canal around these falls, on the Canadian side, called the Welland Canal, has been in operation for several years, and will be noticed hereafter.

New Jersey.

Delaware and Raritan Canal extends from Bordentown to New Brunswick, forty-three miles. A navigable feeder from Bool's Island to Trenton is twenty-four miles long. Morris Canal, extending from Jersey city to Easton, is 101 miles long. Salem Canal, from Salem Creek to the Delaware, is four miles long.

Pennsylvania.

During the last eight or nine years, Pennsylvania has engaged in works of internal improvement more extensively than any other state in the union; and the Pennsylvania Canal and Railway, extending from Philadelphia to Pittsburg, a distance of 395 miles, is the most magnificent work of the kind which has yet been completed in any part of the United States. It consists of the following parts:

	Miles.
1. Columbia Railway, from Philadelphia to Columbia	81·60
2. Pennsylvania Canal, central division, or eastern and Juniata divisions, from Columbia to Hollidaysburg	171·75
3. Alleghany Portage Railway, from Hollidaysburg to Johnstown	36·69
4. Pennsylvania Canal, western division, from Johnstown to Pittsburg	105·00
	395·04

1. Columbia Railway commences at Philadelphia, passes Downingstown and Lancaster, and enters Columbia, on the Susquehannah, by an inclined plane 1720 feet in length. It has thirty-one viaducts, seventy-three stone culverts, and eighteen bridges. It attains its greatest height at Mine Ridge, which is 555 feet above tide-water in the Delaware.

2. The central division of the Pennsylvania Canal commences at Columbia; follows the east bank of the Susquehannah, crossing the Union Canal at Middletown; passes Harrisburg; crosses the Susquehannah at the head of Duncan's Island; and enters the valley of the Juniata, which it follows to Hollidaysburg. It has thirty-three aqueducts, and 111 locks.

3. The Alleghany Portage Railway, connecting the central and western divisions of the Pennsylvania Canal, commences at Hollidaysburg, passes over the range of the Alleghany Mountains, and terminates at Johnstown. It has one tunnel through a mountain ridge, and ten inclined planes, with stationary engines, five on each side of the summit-level, their total length being 4·37 miles. The total rise and fall is 2570·29 feet.

4. The western division of the Pennsylvania Canal commences at Johnstown, traversing the valley of the Conemaugh, Kiskiminetas, and Alleghany Rivers, and terminates at Pittsburg. It has sixty-four locks, sixteen aqueducts, sixty-four culverts, 152 bridges, and a remarkable tunnel about 1000 feet long.

The Beaver Canal extends from the town of Beaver, at the entrance of the Beaver River into the Ohio, to Newcastle, and is twenty-five miles long. The Mahoning and Beaver Canal, extending from Newcastle in Pennsylvania to Akron in Ohio, on the Ohio Canal, is now in progress. The Pittsburg and Erie Canal, of which the Beaver Canal is a part, is intended to connect the Pennsylvania Canal at Pittsburg with Lake Erie, and is to be seventy-three miles and a half long. There are various other canals in this state, besides some which are in progress, and others which are only projected.

Delaware. The Chesapeake and Delaware Canal, which connects the Delaware River with the head of Chesapeake Bay, is partly in Delaware and partly in Maryland, and commences at Delaware city, about forty-two miles below Philadelphia. The length is 13·63 miles, the breadth at top sixty-six feet, and the depth ten feet.

Maryland. The Chesapeake and Ohio Canal, begun in 1828, commences at Georgetown, on the Potomac, in the district of Columbia, and extends to Harper's Ferry. Its course, as laid out, extends to Cumberland on the Potomac, thence by Will's Creek, Youghiogeny, and Monongahela Rivers, to Pittsburg. The total length, as proposed, is 341 miles and a half, and the lockage 3215 feet. It requires a tunnel through the Alleghany Mountains of four miles and eighty yards. Port Deposit Canal, ten miles long, is designed to overcome the rapids of the Susquehannah above Port Deposit. The Chesapeake and Delaware Canal has been already noticed.

Virginia. The Canal of Dismal Swamp commences at Deep Creek, about seven miles above Norfolk, and proceeds southward about thirteen miles to the boundary of this state, beyond which it is continued about nine miles in North Carolina, to Joyce's Creek, a branch of the Pasquotank. This canal is thirty feet wide at bottom, and eight deep. Very extensive improvements have been projected and partly executed on the river navigation of Virginia, by means of lateral canals or side-cuts. One on James River extends from Richmond for twenty-three miles up the side of that river, and then joins it again. There are various side-cuts on the Roanoke; one extends about twelve miles from Weldon upward, but that is after the river has got into North Carolina.

North Carolina. Dismal Swamp Canal, already mentioned amongst those of Virginia, enters about nine miles into North Carolina; and Lake Drummond Canal, five miles long, is a navigable feeder of it. North-west Canal, six miles long, connects North-west River with Dismal Swamp Canal. Weldon Canal, twelve miles long, forms the commencement of the Roanoke Navigation, extending around the falls of the Roanoke above the towns of Weldon and Blakely. The navigation of the Roanoke from the Weldon Canal to the town of Salem in Virginia, a distance of 232 miles, as likewise the Cape Fear, the Yadkin, the Tar, the Catawba, and New Rivers, have been greatly improved.

South Carolina. Santee Canal, twenty-two miles long, connects the harbour of Charleston with the Santee. By means of this and the Santee and Congaree Rivers, the navigation of which has been improved, a communication is opened between Charleston and Columbia. The navigation of the Catawba has been improved by five small canals of two, one and a quarter, two and a quarter, one and three quarters, and four miles. Saluda Canal, of six miles, extends from the head of Saluda Shoals to Granby on the Congaree. Drehr's Canal, of one mile and a third, is designed to overcome a fall of 120 feet in the Saluda River. Lorick's Canal, on Broad River, one mile and a half above Columbia, is a mile long; and Lockhart's Canal, in Union District, around Lockhart's Shoals in Broad River, is two miles and three quarters in length.

Georgia. The Savannah and Ogeechee Canal, sixteen miles long, extends from the city of Savannah to Ogeechee River. An extension of this canal to the Alatamaha, sixty miles, is proposed.

Alabama. Huntsville Canal, from Triana on the Tennessee, to Huntsville, is sixteen miles long. A canal of thirty-seven miles, from the head of the Muscle Shoals to Florence, is considerably advanced, but not yet completed.

Louisiana. A ship canal, of eight miles, has been projected at New Orleans, to lead from the Mississippi to the ocean. It is to commence about three miles below Fort Jackson, and pass through the prairie on the left bank of the river. Besides, there are in progress the Orleans Bank Canal, of four miles and a quarter, from New Orleans to Lake Pontchartrain; the Carondelet Canal, of two miles, which likewise connects New Orleans with Lake Pontchartrain, through the river or bayou St John, which is four miles, making the whole line six miles; and the Barataria Canal, proceeding from the Mississippi, six miles above New Orleans, to the Lafourche, thence through the lakes to Berwick's Bay, and thence to the sea by Barataria. It consists of four parts, amounting to twenty-two miles, which connect an extensive river navigation. The whole exceeds ninety miles.

Kentucky. Kentucky River Navigation, in the course of being executed, viz. the part of that river about to be rendered navigable by locks and dams, extends from its mouth up to where it branches into the three forks. For about 250 miles the whole will be slack water, adapted for steamboats of 150 tons burden. The locks are to be 175 feet long by thirty-eight wide in the chamber, ten feet above the dam; the depth of water is to be six feet; the lift of the locks from twelve to sixteen feet; the dams from twenty to twenty-five feet high, and from 400 to 500 long, and about seventy feet at the base. A variety of improvements, some of them of considerable extent, on other river navigations in this state, have also been projected, and are partly in progress.

Ohio. The Ohio Canal, which extends from Cleveland upon Lake Erie, to Portsmouth on the Ohio River, is 307 miles long; it was begun in 1825, and completed in 1832. The summit-level is 305 feet above Lake Erie, 499 above the Ohio at Portsmouth, and 973 above the Atlantic. It has 152 locks for a lockage of 12,050 feet. The distances along this canal, beginning from Cleveland, are, to Akron thirty-eight miles, New Portage nine, Massillon twenty-one, Bolivar twelve, New Philadelphia fourteen, Gnadenhutten thirteen, Coshocton twenty-six, Newark forty, Bloomfield fifty-two, Circleville eleven, Chillicothe twenty, Piketon twenty-four, Portsmouth twenty-seven. It has three navigable feeders, amounting to thirty-three miles.

The Miami Canal, which extends from Cincinnati to Dayton, is sixty-nine miles long; it was begun in 1825, and finished in 1830. The summit at Dayton is 175 feet above the Ohio at Cincinnati. It has thirty-two locks for a lockage of 296 feet. This canal is now in the course of being extended along the valleys of the St Mary's and Au-Glaize Rivers, and is to be united at Defiance with the Wabash and Erie Canal, which extends from Lafayette on the Wabash River in Indiana, to near the entrance of the Maumee into the west end of Lake Erie. It is 187 miles long, and is nearly completed. The whole extent of this united line, from Cincinnati to Lake Erie, is about 265 miles, of which 105 are in Indiana.

The Mahoning and Beaver Canal, now in progress, extends from Newcastle, in Pennsylvania, on the Beaver division of the Pennsylvania Canal, to Akron on the portage summit of the Ohio Canal. It is eighty-five miles in length, but of this eight miles are in Pennsylvania. Sandy Creek and Little Beaver Canal, also in progress, extends from Bolivar on the Ohio Canal, in an easterly direction, to the Ohio River. Various other extensive navigations have been projected in this state, and companies have been formed for carrying them into execution.

Indiana. Several extensive canals and river navigations have been projected in this state, and are partly in progress. We have already mentioned the Wabash and Erie Canal, of which part is in Ohio.

Illinois. The Illinois and Michigan Canal, now in progress, ex-

Navigation, Inland.

tends from Chicago on Lake Michigan, to Ottawa on Illinois River, a distance of about ninety-five miles. It is to be sixty feet wide at the surface, thirty-six at the bottom, and six deep. About twenty-four miles of this line are to be cut from seven to twenty-eight feet deep, through solid rock. Other canals have been projected in this state.

District of Columbia. The Washington Branch Canal, of one mile and a quarter, connects the Chesapeake and Ohio Canal with the Potomac at Washington. The Alexandria Canal, of seven miles and a quarter, extends from that town to the extremity of the Chesapeake and Ohio Canal at Georgetown.

Florida Territory. It has been proposed to connect the Atlantic Ocean with the Gulf of Mexico, by a canal across the northern part of the peninsula of Florida.

Canada.

Some considerable works for promoting inland navigation have likewise been executed in Canada. Of these the following are the principal ones.

The Rideau Canal commences in about long. 75. 35. E., and lat. 45. 20. N., at Entrance Bay, in the Ottawa River, about a mile and a half from where the Rideau River falls into it, 128 miles from Montreal, and 130 from Kingston on Lake Ontario. It is not so properly a canal as an artificial concatenation of natural lakes. The general direction is south-westerly, to its termination at Kingston; and the total length of the navigation is 132 miles, of which about twenty only are artificial cuts connecting Rideau River and Lake, Mud Lake, Cranberry Lake, and Kingston Mill-Stream. The difference of level is 445 feet, with forty-seven locks, which are each 142 feet long, thirty-three broad, and five deep. This canal, it has been fancied, would be of immense importance for the conveyance of military stores; but this seems to proceed on the assumption that the enemy is to be perfectly torpid during the half year in which the canal is useless from being frozen.[1]

The Welland Canal, connecting Lakes Erie and Ontario, communicates with the latter by the Twelve-mile Creek, and thence ascends the barrier of Lake Erie, near the Falls of Niagara, by means of locks, till it meets the Chippawa, which it ascends for some length, and then joins the Ouse at about a mile and a half from its entrance into Lake Erie. The shifting bar at the month of this river has been remedied by extending piers into the deep water. A safe communication between these great lakes is thus effected by this navigation, which is forty-one miles long; the artificial part being fifty-six feet wide, and eight and a half deep. It has thirty-seven wooden locks, each 100 feet long and twenty-two feet wide, overcoming a height of 330 feet. A much shorter canal for passing round the Falls of Niagara has been proposed on the American side.

Grenville Canal consists of three detached parts, of the nature of side-cuts, or lateral canals; one at the Long Sault on the Ottawa, another at the fall called Chûte à Blondeau, and the third at the Carillon Rapids. This canal renders the navigation of the Ottawa between the Rideau and Montreal complete; but unfortunately some of the earlier constructed locks are only twenty feet wide.

La Chine Canal is a cut of seven miles across the south-east corner of the island of Montreal, to avoid some difficult parts of the St Lawrence, particularly the rapid of St Louis. It is forty-eight feet wide at top, twenty-eight at bottom, and five feet deep, with a fall of forty-two feet; but the locks only admit boats twenty feet wide.

By means of these great and useful works, a large extent of country is opened up to the industry of settlers. There is a continuous steam-boat communication in Upper Canada of about 460 miles, from the Grenville Canal, on the Ottawa, to Niagara. Many other canals are now in contemplation, such as that projected between the bay of Quinté and Lake Huron. A great deal of information regarding the inland navigation of Canada will be found in the Parliamentary Reports, and a more compendious account of it in Martin's History of the British Colonies.

North American rivers. The navigable rivers and lakes of North America are numerous and important, several of them being of vast extent. But a very general feature in such of its rivers as fall into the Atlantic, is a bar obstructing their mouths. That of the principal month of the Mississippi had, in 1722, about twenty-five feet of water upon it; Ulloa, in 1767, found twenty feet at the highest flood; and in 1826 the depth was only sixteen feet. Above these obstructions the rivers are generally much deeper, the Mississippi at New Orleans being above 100 feet deep, which depth it preserves to the mouth of the Missouri. Mobile Bay is crossed by a bar having only ten feet of water; and the bar of the Altamabo of Georgia has fourteen feet, which is perhaps about the average depth to be found at the entrance of most of the southern rivers of the Atlantic coast. Lake Superior, in the great central plain of this continent, is the largest body of fresh water on the globe. The outlet of this, and of the other great lakes of Canada, forms the river St Lawrence, which is of vast dimensions, the tide flowing up it for 400 miles, and affording navigation for the largest vessels the whole of this distance; but above this the current is extremely rapid. Several of the most difficult parts have already been avoided by means of side-cuts and locks, particularly the rapid of St Louis; and others may be disposed of in a similar manner. Vessels of 600 tons ascend to Montreal, and boats all the way to Lake Ontario, and thence to Lake Erie through the Welland Canal. The Connecticut is a large navigable stream entering the sea near the north-eastern extremity of Long Island. The Hudson has enabled New York to extend its commerce by the Erie Canal to the lakes, being navigable to 160 miles above its mouth for large steam-vessels. The Delaware and its tributaries afford a navigation over an extent of 300 miles in length and breadth. The Susquehannah, the Potomac, and others falling into the Chesapeake Bay, together with canals, afford navigation for vessels of one sort or other into the remotest valleys and recesses of the eastern country. The Roanoke, which falls into Albemarle Sound, together with the Pamlico, afford a medium of commerce for North Carolina; whilst the Pedec, Santee, Savannah, Ogeechee, Alatamaha, &c. are so many canals intersecting South Carolina and Georgia in all directions. The St John, again, affords a similar convenience for East Florida. But although the eastern rivers have been by much the longest employed for the purposes of navigation, they are in many respects inferior to the immense streams which intersect the western and inland states, particularly the Mississippi and its tributaries, which have no parallel in any other country possessed by a people sufficiently intelligent to turn the commercial facilities of its inland waters to proper advantage. The Mississippi is navigable for 3000 miles up from its mouth to the Falls of St Anthony, and extends over fifteen degrees of latitude. At St Louis it receives the Missouri, which above that junction is greater than the other branch, which still bears the name of Mississippi. The principal tributaries of the Missouri are the Osage, Grand River, Kanses, Platte,

[1] Canals, it is true, which are all on one level, as is the case in Holland, may become convenient roads whilst the ice is sufficiently strong; but where locks occur, and are so numerous as on this canal, they form a serious obstruction; and it is besides considered necessary in America to have canals as empty as possible during the frost.

White River, Chien, Yellow Stone Rivers, each of which on an average adds 1000 miles to the navigation; and there are many others of less note. Above the junction of the Missouri the Mississippi receives, from the east, in latitude 37°, the Ohio, which is of great importance, as affording a direct communication with the eastern states, and being, besides, the channel of a great inland commerce. About 1200 miles from its mouth the Ohio receives, near Pittsburg, the Monongahela and the Alleghany Rivers. It is connected with Lake Erie by means of the Ohio Canal, and has fifteen large navigable tributaries. The other principal tributaries of the Mississippi more to the north, and each navigable 400 or 500 miles, are the Illinois, Des Moines, Rock River, and St Peter's, between some of which and the great northern lakes there are only short portages. Besides all these, North America contains a vast number of other navigable rivers, which our limits will not admit of our describing.

SOUTH AMERICA.

The vast region of South America, though it has hitherto been kept in a sadly degraded state, by priestcraft, ignorance, slavery, and incessant wars, possesses a conformation peculiarly favourable to an extensive inland navigation. The Andes skirt its western shore, and, though ascending to a great height, are yet so small in breadth as to leave between them and the eastern coast a vast extent of comparatively flat country, divided into the basins of the Orinoco, Amazon, and Paraguay, none of which is much elevated above the sea; and even the dividing ranges between them are generally of very trifling altitude. Thus the Orinoco is navigable, without difficulty, for 260 leagues, to the falls or rather rapids of Atures, where, according to Humboldt, its mean height above the sea does not exceed 350 feet; and thence, after two short portages, it is navigable for above 100 leagues more, to the point near Esmeralda, where the celebated bifurcation of this river takes place, and a portion of its waters descends along the natural canal of Casiquiari, to join the Rio Negro and the Amazon. On both sides, along its course, the Orinoco receives many tributaries; of which three in particular, the Apure, Meta, and Guaviore, flowing from the westward, have also long navigable courses. The Amazon, again, is navigable to a little above Urarina, near the confluence of the Guallaga, a distance of 750 leagues from its mouth, flowing uniformly along the whole extent, in a direction from west to east, and receiving many tributaries on both sides. By the Napo, Putamayo, and Japura it is connected with the higher districts of Columbia; its own upper navigation, which is uninterrupted above Santiago, connects it with Upper Peru; and the Guallaga and Ucayale descend to it from the south-west, along the eastern face of the Andes, from distances, as it is said, of from 300 to 500 leagues. By the Rio Negro, as already noticed, its waters communicate with those of the basin of the Orinoco; the Rio Branco ascends from this also to within a short and nearly level distance of the sources of the rivers Essequibo and Demerara; and its southern tributaries, rising in the Campos Pareceis (the mean level of which west of Villa Boa, and in about 16° south latitude, where the waters divide, is not probably above 2500 feet), approach so closely to the sources of the Paraguay and its feeders, that near Villa Bella, in Matto-Grosso, only a short portage of three miles divides the course of the Aguapehy, falling into the Jaura and Paraguay, from that of the Guapore, joining the Madeira and Amazon; and, lastly, the Paraguay itself is navigable through nineteen degrees of latitude, from the confluence of the Jaura in 16° 20′ south, to its mouth in the Rio de la Plata, near Buenos Ayres, in 35° south lat., and receives also many tributaries along its course, of which four only need be cited, viz. the Parana and Uruguay from the eastward, rivers each nearly equal to the main trunk in value and importance; and from the west the Pilcomayo, said to be navigable with very little interruption as far as Chuquisaca; and the Vermejo, in which there are three fathoms as high as the junction of the Rio Grande, and large boats ascend beyond it as far as Tariga.

From these facts, then, it appears that, with the exception of one short portage of three miles, water flows, and is for the most part navigable, between Buenos Ayres, in 35° south, to the mouth of the Orinoco, in nearly 9° north latude. The distance across the continent from east to west, through which the same convenience exists, varies greatly in different lines; but in the basin of the Orinoco it is not under 400 leagues, in that of the Amazons it is nearly 1000, and in that of the Paraguay it varies probably from 200 to 500. That all the interior provinces of South America would be prodigiously benefited by advantage being taken of these facilities for internal communication, cannot admit of a doubt; but the districts which are at present the most secluded, and which would be most strikingly improved by it, are those of Moxos, Chiquitos, and Santa Cruz de la Sierra, which contain about 43,000 square leagues, and produce a great variety of valuable articles, which are unavailable on account of there being no method of transporting them. The only seaport with which they have any communication is Lamar (Cobija), on the Pacific, although the junction of the Jaura with the Paraguay, where the latter becomes navigable, is only seventy leagues from Santa Anna, the capital of Chiquitos, a hundred from Santa Cruz de la Sierra, and seventy-three from Villabella in Matto-Grosso.

It has long been proposed to form a communication between the Atlantic and Pacific Oceans, by means of a canal across the Isthmus of Panama. A very interesting account of a survey of a line across the isthmus, which was made a few years ago by Mr J. A. Loyd, will be found in the Philosophical Transactions for 1830; and some account of a different line by the Lake of Nicaragua is given by Captain Philips in the Journal of the Royal Geographical Society (vol. iii. 275). There can be no question that a ship canal, if practicable, would be greatly preferable to any other equally slow communication; and a railway, again, better than a small canal. A line partaking of both is also talked of.

CONSTRUCTION OF CANALS, TUNNELS, LOCKS, &c.

Canals formed for navigation are generally upon a dead level from lock to lock, except when they are also intended for conveying water, whether to other parts of the navigation, or for some different purpose. Feeders or conductors of water to canals should always have a certain declivity; but even in these it is not customary to give the bottom a greater descent than four inches in the mile. The simplest mode of constructing a canal over level ground, is to form it partly by excavation and partly by embankment; that is, to proportion the depth of digging such, that the stuff thrown out shall exactly embank or raise the sides sufficiently to make the canal of the required dimensions. This is called level cutting. But when a canal runs along the side of a declivity, the one bank will require more raising than the other; or the cutting may be all at one side, and the embankment only at the other. If, again, the surface of the ground is undulating, the case becomes more complicated; but it is always a desideratum in the formation of canals, that the stuff excavated from one part may, with the least labour or shortest carriage, exactly supply or form the embankments that are to be raised in another; so that, at the completion of the work, as few spoil-banks or mounds of useless soil as possible may remain, and as little ground as possible be rendered useless by excavations or pits. However, the great expense of rock-cuttings, and other difficulties, often occasion a wide departure from this rule. For, in conducting a canal across a hilly and rugged country, there are many difficulties to be overcome, much levelling, and many works of art to be executed. Some of these, perhaps, cannot be foreseen till the operations have been commenced or are far advanced. The slopes of the banks are regulated by the quality and difference in the tenacity of the soil; but they are seldom made greater than two feet of perpendicular to three of horizontal measurement, particularly where the embankments are heavy. The inside slope soon becomes chafed and indented at its upper edges by the motion of the water, which is occasioned by the passing of boats; and this abrasion often penetrates so much as to diminish irregularly the width of the towing-path. This may be remedied in a good measure by planting the sides with aquatic shrubs, and also by driving stakes into the bank at short intervals along the water line, so as to form a rude wicker-work, in places where the soil is loose and porous. The Caledonian Canal is provided with a break in the slope for this purpose, as was mentioned in the description of it. But the most effectual protection against the action of the water is attained by walling or paving the sides of the canal for some breadth both above and below the water line. This, however, from its being expensive, has not yet been extensively resorted to; but when it is recollected that the washing of the banks of a canal not only destroys its security, but diminishes its depth and the facility with which it is navigated, this reason loses its weight. By facing the sides with a substantial wall, which might be made nearly vertical at the top, the surface of the water need not be much more than two thirds the usual width, and consequently the canal need not occupy much more than three fourths the extent of ground; so that in situations where the ground is valuable, the wall would conduce to economy. The canal, too, having less earth crumbling into it, would need less cleaning; and where water is scarce, the smaller waste by evaporation, from the contracted breadth of the surface, would be of importance. To prevent as much as possible the wash, as it is termed, the speed of the canal-boats is variously restricted, and steam-boats have generally been excluded.

It frequently happens that canals have to be formed more or less by artificial embankments of loose materials, or that they are excavated in earth, sand, rock, &c. so very porous as to allow the water to escape by filtration. To remedy this, the usual method is to make the excavation much wider and deeper than the intended dimensions, and to line it to the thickness of two or three feet with a tenacious clay mixed with gravel, which is to be thoroughly puddled, and then, according to some, exposed for a long while to the weather, though others condemn exposing it at all. A trench four feet in width is also dug out in the middle of each side-bank, to at least three feet below the bottom of the canal, and this in like manner is to be filled up with puddle. The puddle trench is made principally with the view of preventing rats and other vermin from perforating the banks, and occasioning breaches, as they often do. When once the water has obtained a very small egress, it gradually washes it wider; so that sometimes in a few hours a breach may be formed sufficient to empty the canal, and require weeks or even months ere it can be repaired. But besides being able to resist the penetration or gradual escape of the water, an embankment must always be composed of materials capable of withstanding, by their weight, the tendency of the hydraulic pressure to overturn them in a mass, and also of resisting, by their lateral adhesion, the force tending to thrust them out horizontally. When the side of a canal gives way, it is of great consequence to prevent as much as possible the escape of the water. For this purpose, it is usual to have doors or valves in various parts of the canal, so attached by joints or hinges to the bottom, that when the water is at rest they lie nearly flat at the bottom, but when it begins to flow rapidly over them, they rise by its force, and arrest its farther progress. However, when such gates have lain long in the bottom, and have become coated with slime and imbedded in the mud, their spontaneous rising at the proper time is not much to be depended on, and therefore they should be provided with chains or rods, by which they may be drawn up when required.

Tunnels.

The first thing to be attended to in constructing a tunnel is to execute a correct survey of the ground through which it is intended to pass. This is done by tracing over the surface of the ground a line which shall be all in a vertical plane parallel to the direction of the tunnel, and which, when transferred upon a reduced scale to paper, shall accurately represent a vertical section of the ground. To obtain a section of this sort with accuracy for an extensive tunnel, the relative levels of the principal points along the line upon the surface are to be ascertained; and it is generally necessary to use an instrument similar to a transit telescope, and perhaps to fit up one or more temporary observatories upon the most elevated spots along the line, from which may be determined the position of any pits or shafts which it may be necessary to sink, whether for the sake of free ventilation, or for commencing and carrying on the excavation of the tunnel at several different places at the same time. Through these openings the stuff is to be hoisted up, and the water pumped out should any occur. The shafts being sunk to the requisite depth, which is ascertained from the levels which have been taken at the surface, a heading or small tunnel, at least sufficiently high and wide to allow the men to move freely in the work of excavation, is to be commenced just below the crown of the intended large one. Such smaller excavation is generally made very unshapely in the sides and roof, but ought to be nearly flat in the bottom. It is to be carried forward from one working shaft to another, as nearly as may be in a straight line, till a connection be formed between all the shafts and the ends of the tunnel. If, in the progress of the heading from one shaft to another, the air become so bad as to oblige the workmen to desist, an air shaft is to be immediately commenced from above, about five or six feet in diameter, and sunk vertically to the point at which the heading was left off. In excavating the tunnel of the Thames and Medway Canal, there were twelve working shafts; and, on account of the foulness of the air, it was besides necessary to sink eleven air-shafts. After the heading has been driven from one working-shaft to another, or a complete perforation obtained throughout the whole of the intended line, the roof of the tunnel is commenced, by an excavation in the form of a circular, an elliptic, or a parabolic arch. At this stage of the work the strength and quality of the roof are easily ascertained; and where weak and crumbling portions occur, a brick or stone arch must be formed for their support. The stuff is generally carried out by means of a railway. Some tunnels are formed in strata of such a texture as to require no building whatever, unless, perhaps, in fitting up a towing-path; whilst others are so very insecure that the construction of a complete lining of building must keep pace with the work of excavation. Some tunnels, again, are naturally water-tight, whilst others require a substantial lining of clay, and must be excavated of so much the larger dimensions as to have room for it.

Inclined Planes.

It is probable that the earliest mode of passing a boat from one level to another consisted in simply dragging it over the intervening space, whether that might be a natural rapid in a river, an obstructing rock, or a dam built across on purpose; and this last was generally in the form of a ridge, or double inclined plane. In a rapidly descending current it was necessary to have many such dams at short intervals, in order to obtain the requisite depth of water. In China these inclined planes have been long in use, especially in their smaller canals. Between the upper and lower levels of the water a double glacis of hewn stone is built, the principal slope of which extends from the bottom of the lower canal to the surface of the water in the upper canal, or a little above it, and there terminates in a large cross beam of wood, rounded off, and very smooth. From this beam another but shorter and steeper plane of stone descends to the bottom of the upper canal; and over these the boats are dragged, sometimes by simple manual power, and sometimes by the aid of capstans. It is not uncommon in China for a hundred men to be employed in drawing up a large vessel from the lower to the higher canal. Their strength is usually applied by means of levers turning capstans, which are placed on the abutments on each side of the glacis. A rope being passed round the stern of the vessel, has its ends attached to and wound round the capstans. In this way a vessel is more speedily raised into the upper canal than if locks had been employed; but it is effected by a prodigions exertion of human force, which, however, in China is always to be had at little cost, and is there preferred to any other. When a vessel is to be transferred from the upper to the lower canal, she is, as before, lifted over the cross beam, and then glides safely down by her own weight. To insure this, the head of the vessel is provided with a railing, which being covered with a strong matting at the time of the descent, not only breaks the fall, but prevents any water from flushing up over the deck. We here see human power sadly lavished away where a very different one might suffice. Horses, oxen, water-wheels, &c. are in some countries applied to turn machinery for the same purpose. To lessen the friction, long rollers are sometimes placed across the inclined planes, at short intervals from each other; but it is evident that, whether with or without rollers, boats which will bear to be dragged over any such structure must be excessively strong for their size. The long feeble boats which usually navigate canals would undoubtedly break into several lengths were they to be passed over the ridge. Sometimes the boats are placed upon a sort of cradle or hurdle, with or without wheels, and the whole dragged over; and sometimes the boats themselves are furnished with wheels, which only come into play in passing such planes.

There have been numerous other contrivances for transferring boats from one level to another, without any expenditure of water; and descriptions of the most of them will be found in some of the scientific journals, particularly in the Repertory of Arts, Nicholson's Journal, the Philosophical Magazine, and the Repertory of Patent Inventions. But these have generally been very unsuccessful, although for not a few of them patents have been obtained. One of the most recent patents is that of Mr Thomas Grahame, of which the specification is published in the Repertory of Patent Inventions for March 1837. By far the greater number of the schemes now alluded to would require an exertion of mechanical force which would either be more than sufficient to raise water to fill a common lock, or would be attended with greater expense. Some of them, it is true, might save a little time, but in general the case would be otherwise.

Locks.

Amongst the many approximations to the gates of a lock, the following rude one may be mentioned, especially as it is still used in various parts of England. A beam or sill is fixed across the bottom of the stream or canal; and directly over this, but at the water's surface, is placed a second but moveable beam. Against and behind these parallel beams a set of loose boards are placed upright and close together like a door, so as to obstruct the progress of the stream. When a boat is to pass, the boards are either removed singly, or, if they can be prevented from floating away, the upper beam is lifted or moved round, so as suddenly to let go the whole system, and thus afford a temporary increase of depth, to enable the boat to pass or repass the otherwise too shallow water. In China it is common to have a similar set of loose boards or planks, but placed horizontally across the stream; these being dropped one by one into grooves formed in the side walls, or in upright posts, from which the boards are to be singly removed in a similar manner. Such are the sluices or gates used on the Imperial Canal of China; for the emperor's boats or barges are far too large to be dragged over inclined planes. Machines of the same sort have also been used on the river navigations in Flanders. Since both the kinds of gates now described are supposed to be placed at the upper end of the fall or shoal over which they are temporarily to increase the depth of water, and since the boat is to pass through the gate, while the accumulated water rushes out with great force, it is evident that this must render it difficult for a boat to ascend the stream, and must accelerate it too much in descending. However, a method similar to this, at least in letting go a flash of water, has long been used in floating down rafts of timber over shallows and rapids in rivers, and is perhaps the best that could be contrived for the purpose. But for the navigation of boats there is a greatly preferable mode of using the same sorts of gates, so as to be free from the inconveniences above mentioned; which is to place the gate in moderately deep water at the lower end of the fall or shoal, and such that a boat may pass up through the gate before the water has been raised by it at all. The gate is then shut till the water rise sufficiently to enable the boat to ascend the fall or shoal, which it does in almost still water. These sorts of gates Lalande calls half-locks; and indeed it is supposed, with considerable probability, that the casual position of two of them near each other had given rise to the invention of the lock. For in that case it would soon be seen, that when the lower of these two gates was closed, and the water above it had risen to a sufficient height, such water would be nearly stagnant at the upper gate, and would afford an easy passage through it. If, therefore, the boat was ascending, the upper gate being next shut, the water above it would rise, and enable the boat to proceed a stage farther in its ascent.

Modern locks.

However the real origin and early history of the modern lock, like those of many other valuable inventions, are involved in obscurity, yet its nature and mode of operating will be readily understood by a reference to figs. 1 and 2, Plate CCCLXXVIII. where A A A A are the walls of the lock chamber, which can be closed by the two single gates G,G. The water in the part or *reach* of the canal which lies to the right of the lock is supposed to be higher than in that to the left. When, therefore, it is wished to pass a vessel upwards through the lock, she is first floated in at the lower gate, previously opened, as shown in fig. 1, and which is next to be shut. Water is then admitted through a valve from the upper canal into the lock-chamber, till it has filled it up to the same level, and has of course raised the vessel along with it. The upper gate being next opened, the vessel quits the lock, and passes immediately into the higher part of the canal. This process is called *locking up;* and the reverse of it, or *locking down*, will obviously conduct a vessel down through the lock, which is to be emptied by another valve into the lower reach of the canal. For when the water in a lock is reduced to the lower level, it is usually said to be *empty*, although it has still the same depth of water as the lower canal.

In navigations where great differences of level are to be overcome, it is not unusual to have two or more locks following in such close succession that the lower gate, or pair of gates when they are double, of one lock, forms also the upper gate or upper pair of the next lock below it. This obviously tends greatly to lessen the cost of constructing them, and also requires fewer lock-keepers. It tends, besides, to lessen the time spent in the repeated stoppages and startings in the trackage of the boats; though it is rather blamed for expending somewhat more water than if the locks were scattered separately over a considerable extent.

It was not until artificial canals had become very general, that locks were brought to any thing like their present state of perfection; for the difficulty of procuring water had been but partially felt, as long as inland navigation was confined to a few rivers. But when the value of water for canals came to be properly appreciated, it was necessary to be careful of every resource, and to use it with the strictest economy. With this view the chamber, or the space between the upper and lower gates, instead of being made of an oval, a circular, or an octagonal figure, as in the locks on the earlier canals, was so much contracted as only to afford room for the vessels to pass through; to effect which, the sides were made vertical planes formed of wood, brick, or stone, instead of the sloping banks of earth or turf used in the older locks, and which required such a length of time to fill or empty them, and consumed a vast quantity of water besides. The *lift* of the lock, or the difference of level which it is made to overcome, is regulated by circumstances. It varies from one foot or less, up to sixteen or eighteen feet. Where the levels of the parts of a canal, or of the several *reaches* as they are sometimes called, differ greatly, and where water is plentiful, the locks are generally made with a greater lift than where the ground is more flat and the water scanty. For a given difference of level, locks generally consume more water as the lift of each is greater; but, on the other hand, they tend to save time. The chambers of narrow locks are generally from seventy to eighty feet long, and from seven to eight feet wide. Those of the Caledonian Canal are from 170 to 180 feet long, forty wide, and thirty deep; and still larger ones are used on the great ship canal from the Texel to Amsterdam; but locks are also made of every intermediate dimension.

A naturally hard bottom is the best foundation for the walls of locks; but where that does not occur, they are frequently built on a system of piles well driven and bound together; for the mode of preparing the foundation must be regulated by the nature of the ground. The sides are carried up sometimes in straight, sometimes in curved lines, and often reclining or battering outwards from the bottom. In this last case, too, the beds of the stone or brick-work are generally formed at right angles to the face of the wall, inclining from half an inch to an inch in the foot. Such battering, however, should only be used near the bottom; because, *cæteris paribus*, a lock the opposite sides of which are perfectly vertical and parallel planes, and which is of no greater width throughout than to admit the boats, must obviously consume the least water, and spend least time in passing a boat; a circumstance which ought always to outweigh any little saving of materials or expense which might be expected from a different form of construction. Curving the sides longitudinally, like crescents, can add nothing to the strength on the principle of the arch; because such a figure is at best an arch having nothing to abut against. The like may be said of dishing-carriage wheels, and of all curved structures which either have no abutments, or which are not equally pressed against all their abutments. At Agde, on the Languedoc Canal, a circular basin which unites three canals of different levels is used as a lock, and has long been extolled as the very perfection of lock-making; whereas it requires a needless length of time, and wastes an enormous quantity of water in passing a boat. If the foundation be clay or gravel, a wooden bottom is sometimes formed of cross sleepers planked longitudinally, upon which the side-walls are built with or without buttresses at the back, according to the quality of the side-banks. A flat segment or inverted arch of stone or brick is sometimes laid upon the wooden bottom, in order to distribute the weight more equably, and to prevent any partial settling or subsiding of the work; and the same method is observed between the buttresses along the outside of the chamber walls. In each wall, behind the hollow quoins, a recess is left sufficient for the gates to open back into, out of the way of the vessels. In the recesses belonging to the upper gates, a weir or overfall for the water is provided, four or five feet long, having a coping or sill of stone or brick, just the height at which the water is intended to stand in the upper reach of the canal; these are called the paddle-weirs or lock-weirs. A large flat stone is usually laid as a lintel over this opening, to complete the wall upon, and leaving a space of three or four inches in height for the egress of the surplus water. This cavity is conducted downward, diminishing in width and enlarging in depth, behind the walls of the lock, into the paddle-hole or culvert for filling the lock, if such be in use there. This water having got into the lock, makes its escape from it by a similar opening at the other end into the lower canal. In other cases a culvert is purposely continued behind the wall, so as to carry this surplus water quite past the lock to the lower canal. Sometimes an open channel, properly lined with stones or bricks, is made for it. But in many cases, where the surplus water would be of no use in the lower canal, it is allowed to escape over a waste weir, built on purpose in the side of the canal, into some river or brook which may be near. In order that any considerable quantity of water may be readily withdrawn from a canal when required, it is generally provided in various places with waste-gates or sluices in its sides, which can be drawn up either with a rack and pinion, a chain and roller, or a crow-bar, as circumstances may render most eligible. Sometimes pipes furnished with valves are placed in the bottom of the canal for withdrawing the water.

The frame of a lock-gate usually consists of two strong upright posts, connected by horizontal ribs; and the latter are closely covered with boards or planks caulked like a ship. The gate, again, generally turns horizontally on one of these uprights, which is called the *heel*-post or *coin*-post, whilst the opposite one is named the *head*-post or *mitre*-post. Large gates are frequently curved, so as, for greater strength, to present an arched or convex surface to the pressure of the water; and on this point there is an interesting article by Mr Barlow in the Transactions of Civil Engineers (vol. i.). It was usual to make all such gates of timber; but, on account of the difficulty of getting it at the time of sufficient size for those of the Caledonian Canal, the most of the gate-frames for it were made of cast iron, boards being still used for covering the ribs. Other locks have since been similarly constructed; and iron gates cast in one piece have been used on the Ellesmere Canal. But wooden gates are by some engineers preferred to those of

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cast iron, which are apt to corrode and get out of order, especially if exposed to the action of salt water. In England the cost of gates for large lock-chambers is nearly the same, whether they are made of wood or of iron. Some canal gates are made to rise and fall vertically, like those of ancient castles and temples, or, like our common windows, counterpoised by weights, which slide in grooves. The locks on the Shrewsbury Canal are not only closed by two gates of this sort, but can also be divided by others, so as to admit or contain one, three, or four boats at a time, without the loss of any more water than is just necessary to regulate the ascent or descent of the boat or boats that are then in the locks.

As it would on several accounts be inconvenient, and often impracticable, to open lock-gates against a strong pressure, they are either provided with smaller apertures furnished with valves, through which the locks are emptied or filled before opening the large gates themselves; or, instead of apertures in the gates, the water is passed through one or more culverts or pipes formed in the walls of the lock, these being in like manner furnished with sliding valves or paddles. The valves of lock-gates are generally opened and shut by a rack and pinion attached to the lever beams of the gates, and moving in vertical guides spiked fast to the lining of the gates. They are formed of wood, and placed near the middle of the gate at the bottom. A rack and pinion are likewise generally employed to open and shut the valves of culverts.

Sometimes the valve in a lock-gate is formed into a large lever, shaped like a rudder, which extends from near the bottom of the gate, and passes through a guide fixed on the side of the beam. One edge is hinged on a pivot about four feet above the bottom of the opening, the side-works against the lining of the gate, and the top is drawn backward and forward by means of a rack and pinion fixed on the lever beam. This is in some respects a convenient contrivance, being easily worked by the boatmen, without the awkward necessity of standing upon the lever beam.

Another method of constructing the valves, especially for large tide-locks, where the gates have no lever beams, but move upon rollers by means of a drag-chain, is to form two apertures above one another, each about one foot high by two feet wide, and to connect the two valve-covers by links at the same distance apart; so that a motion of one foot perpendicular, given by a coarsely threaded screw, fixed upon the head of a connecting rod, will open and shut four superficial feet of aperture through the gate.

But since all sliding valves are necessarily attended with much friction and wear, and it is likewise inconvenient to have any valve in the gates, we should think a greatly preferable method would be, to use a culvert departing perpendicularly in the bottom of the canal or of the lock-chamber, and to close it there with a horizontal lid or valve, hinged at one edge, and having a long arm or lever projecting from its opposite edge. In this simple construction, it is obvious that a mere rod or chain attached to the lever might have any required degree of power to raise the valve; which, on being let go, would readily, of its own accord, shut down out of the way. This method would scarcely either be attended with friction, or be subject to wear.

Many of the canals of England which have succeeded best are both narrow and shallow;[1] and consequently their lock-chambers are narrow and long, particularly those of the Grand Trunk and Birmingham Canals. Fig. 1 and 2, Plate CCCLXXVIII. show one of these, which is seventy-five feet long and eight wide, with vertical and parallel sides AAAA, built of brick, four feet thick, and coped with stone. The gates G, G are single, hung in a stone quoin or coin, and they shut against a rebate of stone, which is lined on the corners with a cast-iron plate two inches thick and six broad, screwed fast to the coins. The gates are framed simply with square ribs, and a single lining of plank; they contain no valves, as the chambers are filled by side culverts *c t v*, formed through the wall, and entering in the recess left for the gate to fold back into. The valve *v* of these culverts is opened or shut by turning the handle *w*, which works a pinion and rack attached to a post about eight inches square. The gate is opened or shut by pushing round the long lever beam B, which is fixed along the top of the gate, and is purposely made very heavy to act as a counterpoise to the weight of the gate. The lower end of the coin-post, or principal upright post of the gate-frame, has a pivot which turns in a socket at the bottom; and near its upper end, at P, it is embraced by and turns in a collar held by the clamp *a*, which has two long diverging arms made fast in the top of the building.

The lock-chambers built by Brindley upon the Duke of Bridgewater's Canal at Runcorn, upwards of sixty-five years ago, are still in good order. They are formed with vertical sides of brick, coped with heavy stone clamped into the heart of the wall, and are sixty feet long by thirteen wide. The gates are double, and form, in meeting, a very acute-angled mitre. The valves or paddles are opened perpendicularly by a rack and pinion on the beam. There are two of these apertures in each gate, about twenty inches square. The hollow coins or grooves in contact with the gates are of timber, bolted and clamped into the brickwork.

Tide-lock.

Fig. 3, 4, and 5, Plate CCCLXXVIII. represent one of the tide-locks of the Thames and Medway Canal. Its walls AAAA are of brick built upon piles with a wooden bottom, upon which is laid an inverted arch, the sides battering into the bottom curve from the water line. The gates G, G are double, and curved so as to form nearly a circular arch in meeting. Their frames are made of cast iron, and their coin and mitre posts are formed hollow like a pipe, with oblong openings in the sides for the workman to put in his hand with the bolts which are to fix the horizontal ribs. Formerly, when such posts had no openings in their sides, it was necessary that a boy should go inside with the bolts, like a sweep into a chimney. The ribs are about eighteen inches apart, an inch and a half thick, curved in plan, with a flange on each end, which is bolted into the coin and mitre posts. The ribs are covered with planks two inches thick, bolted to the ribs, and caulked in the joints like those of a ship. These gates are very heavy, but rest in a great measure upon rollers, which run on the curved tracks *r*, *r*, *r*, *r* when the gates are moved by the capstans C, C, C, C, and drag-chains winding round them, as seen in fig. 5, and denoted by the long, cross, dotted lines in fig. 3.[2] These chains pass through holes in the walls O, O, as seen in fig. 5, where also the curve I denotes the inverted arch. This lock is filled and emptied through culverts, as described in the account of the single lock of the Birmingham Canal.

As the tide-water flows and rises above that within, it

[1] There is little room to doubt that such would have been still more successful had they been of larger dimensions. However, the contrary error seems to have been committed in the too large dimensions of the Grand and Royal Canals of Ireland, and in the Caledonian Canal.

[2] In some locks, instead of the drag-chain, a pinion is formed on the axle of the capstan, and works into a toothed rack attached by a joint to the gate. As the pinion and rack can work both ways, only one capstan is required for each gate; whereas the chains always need one capstan to open the gate and another to shut it.

pushes open the gates G, G, and passes into the basin and canal; but this can also be stopped or prevented by shutting the gates *g*, *g*, which, opening outward, cannot give way to external pressure. The lock-chamber is 130 feet long within the outer gates, and thirty wide. It is about ten feet deeper than the canal, and eight wider than the tunnel, which is only twenty-two feet; so that much larger vessels may come into the basin, whose bottom is even with that of the lock, than those which can get through the canal. By these means, too, boats drawing almost eight feet, the ordinary depth of water in the canal, may pass through the lock when the tide-water without is ten feet lower than in the canal.

This lock exhibits one feature which, though common a century ago, we should not have expected in a first-rate lock made in the nineteenth century; we mean the curvature of the side walls, which contributes rather to weaken the structure, because, instead of these curved sides acting as arches having something immoveable to abut against, their only tendency in the circumstances is to transfer the lateral pressure from the middle of the walls, where the stress is least, to the very parts on which the gates are hung, and which, of course, already sustain the greatest strain, and therefore have more need of being relieved or assisted, than thus burdened with any such unnecessary or additional strain.

When a boat is to be raised through a given height, there is not necessarily any difference in the expense of water, whether the ascent be gained by one previously empty lock, embracing the whole lift, or by ever so many sharing it; for since the boat on ascending leaves all the locks full, there must at least be as much water used as would fill up one deep lock from the lower to the higher level, and which ought just to fill ever so many shallow ones. However, when the locks have been previously full, the water of one only need be expended, and therefore the less the lift of each, the less will be the expense of water. On the other hand, it is obvious that many small lifts unavoidably put off much time. Again, when a boat is to have a given descent, this may be effected with as much less expense of water as the number of locks, if previously empty, is greater; because, whatever water suffices for one of a series of equal locks, may successively serve each of the rest during the descent. When the locks have been previously full, the whole of them are emptied by the descent of a boat, whether they are many or few. However, there is this difference between an ascent and a descent: A boat in ascending lets down or consumes twice the weight in water of itself and cargo more than it does in descending; because, on entering the empty lock, the boat which is about to ascend expels as much water into the lower reach of the canal as equals the weight of itself and cargo, whereas a boat about to descend expels from the full lock an equal weight of water into the upper reach of the canal. The former is therefore lost, whilst the latter is saved.

The failure of the schemes hitherto projected for remedying the defects of the common lock are ascribed by M. Girard to the impossibility of resolving the problem completely, without an unnecessary expenditure of mechanical force; and he therefore reduces the maximum effect of the common lock to questions of the comparative time and economy required by boats in passing insulated locks, and in passing connected systems of locks. But he does not, says Mr Rennie,[1] consider the stoppage and the loss of time attending the repeated changes in the force of trackage required by the isolated system. The value of the water lost can only be contrasted with the value of time under certain circumstances; but the question had already been discussed by Gauthy and others with reference to the locks of the Canals of Briare and Languedoc.

Economy of Water.

There have been numerous expedients for more effectually economising the water of canals. By making the locks double, that is, placing two equal locks on the same level in the breadth of the canal, a much smaller quantity of water will generally suffice. For since a boat on descending must enter a full lock and leave it empty, whereas an ascending boat must enter an empty lock and leave it full, it would obviously be a saving of water could the full lock, by which a boat had ascended, be reserved for the next boat which should descend, and *vice versa* with the empty one; though it is evident, that when several boats pass together in the same direction, this can only be partially done. But when the one lock is full and the other already empty, and we wish to let down a boat through the former one, half the water might always be let through a sluice into the empty lock, instead of letting the whole go to waste in the lower canal; and in like manner, when we wish to raise a boat through the empty lock, half the water may be obtained from the full one. By putting more than two locks in the breadth of the canal, still less water would sometimes suffice; but the increased cost puts this out of the question.

Side-ponds.

A different method of saving water is by means of *side-ponds*, into which the water is partly withdrawn from a full lock, and reserved for farther use. Sometimes a single side-pond is employed, and sometimes two or more, being all upon different levels. A single pond, no matter how extensive, cannot, in the usual way in which it is employed, save quite half the lockful of water, two ponds cannot save quite two thirds, nor can three save three fourths, &c. But it is most common to employ two ponds, each having the same horizontal area as the lock has, and being made to receive one fourth its fill of water. The one of these ponds has its bottom at half the height or lift of the lock, so that when a valve is opened into it from the full lock, this pond receives one fourth of its contents. This valve is now shut, and another valve opened between the lock and the second pond, which, in its turn, receives another fourth of the water, because its bottom is at one fourth the height or lift of the lock. The second valve is now shut; and the remaining half-full of water in the lock is let go into the lower canal in the usual way. When the lock is to be filled again, the lower pond is first run into it and closed, and then the higher one, which together make up one half of what will fill the lock, and which has been saved by means of the ponds.

Mr Field's improvement.

A great improvement on side-ponds has been proposed by Mr Field (Transactions of Civil Engineers, vol. i. p. 61), which is to apply to them the principle of the pendulum, or rather of water vibrating in an inverted syphon, viz. that it would rise to the same height in the one leg as that from which it has fallen in the other, were it not for friction or other resistance. Mr Field's method is to connect a lock with a side-pond by means of a long pipe or culvert, in such a manner, that when the water in the lock is allowed suddenly to run into the empty pond, it may rise in the latter nearly to the level from which it had fallen in the former; and at the moment this occurs, the valve or sluice in the culvert is to be shut. The same thing should obviously take place when the water is to be restored to the empty lock, excepting that, whatever may have been

[1] Reports of the British Association for 1834, p. 459.

the loss of water in the former case, the total loss will now be doubled; but this additional loss would be avoided by using a second lock alongside of the other, instead of a pond, as no restoration would be required.

On one point we beg to differ materially from Mr Field. In all the five different forms in which he has illustrated his method, he assumes it as absolutely necessary that the long culvert should always have *two* valves, one at each end; and in order to get these two valves near each other, he proposes to bend round the culvert in a spiral or circular form. Now, with all deference, we presume, that if the culvert be kept as low down as it ought to be on several accounts, any more than one valve will not only be troublesome and expensive, but occasion a needless obstruction to the free motion of the water. Indeed, to avoid giving a great and sudden lateral shock to any boat or vessel whilst in the lock, it would be proper that the water should enter or depart perpendicularly in the middle of the bottom of the lock. In that case it would not be very material in what part of the culvert the valve was situated, except for the greatest convenience. It would perhaps be an improvement to give the culvert very wide spreading mouths or ends. If, however, Mr Field's ingenious scheme should save nine tenths of the water, as he expects it to do, it would have the farther advantage, that the gates of such locks could generally be opened without their needing to have any valves or paddles to be previously opened, either in them or in the walls. Mr Field makes his method to depend on the principle of Montgolfier's ram, a principle, we beg to observe, which had been discovered, applied, and published by Whitehurst, long before Montgolfier's time; but it is much more elementary and simple, we presume, to refer, as we have done, so much of Mr Field's scheme as has now been described, to the undulations of water in a syphon.

Where canals are all on one level, and have either no locks at all, or at their extremities only, there is seldom much difficulty in supplying them with water; though in certain cases canals of this sort may communicate with some very muddy river, whose waters, if admitted, would soon silt them up with mud. In such cases it has been recommended to exclude the muddy water, and, if nothing better could be done, to supply the canals with clean water, raised by a steam-engine. This method has been followed in the case of the West India docks on the Thames, where the foul water of that river, after having stood in a basin till it has deposited its mud, is pumped up into the docks by a steam-engine. But where a canal is to form a communication between separate valleys or basins of a country, and where a double lockage is unavoidable, the summit-level which divides the rise and fall is generally too elevated to permit a regular supply of water being drawn directly from the streams on either side. In such cases it becomes necessary to collect the flood waters of the adjacent higher grounds into proper reservoirs, to be used as circumstances may require. Some canals are provided with very large receptacles for the flood-waters. That of Languedoc has one of 595 acres; and one belonging to the Trent and Mersey Canal covers 160 acres. But cases occur in which no such supply can be obtained, and where, of course, it is necessary either to raise water by steam-engines, or to employ inclined planes or machinery to pass the vessels, or at least their cargoes, from one level to another.

RIVERS.

Engineers are generally agreed that side artificial canals are eventually more judicious than the attempts to dredge or to deepen channels in the beds of the streams themselves; and that, for the purposes of navigation, rapid rivers are only useful to supply canals with water. On this account, locks are rarely constructed in the beds of rapid rivers. It is more usual to apply them to side-cuts or to a lateral canal, formed for the purposes of the navigation, and to leave the river course for the passage of the floods or other surplus water. A quick bend of the river is generally chosen for being crossed by a side-cut; and to keep up the water to a sufficient height for navigation in the upper part of the river, a dam or weir is thrown across the old river course, at or rather a little below the upper point at which the artificial cut joins it. The lock is then built at the most convenient part of the cut, generally near the upper end; and its fall or lift is made equal to the difference in the levels of the water at the top of the dam or weir, and in that at the lower end of the cut. But it may happen, that, owing to some rock or other natural obstruction in the river, no artificial dam will be required; and, on the other hand, it is probable that the fall of the river may be so great that several locks will be required in the same cut.

Of the impropriety of placing locks in a rapid current, a remarkable instance may be mentioned in the case of the locks which Polhem, a Swedish engineer, fearlessly attempted, in 1755, to place in the cataracts of Tröllhaetta, in the river Gotha, but which were wholly swept away by a flood, after they had been considerably advanced, and vast sums expended upon them.

In estimating the propriety of deepening shallows in any river, it must be of importance to take into consideration the nature of the shoals. If they have been created by deposits collected by the action of the current, it may be inferred that the same process will continually tend to the same results, and that any efforts to preserve the channel clear will require to be perpetual and laborious; but if the obstructions have been artificially made, or consist of a natural and solid substratum, it may be reasonable to presume that the excavations once made will either be permanent, or, at all events, be easily maintained.

Regarding the main question, whether the free and natural flow of the floods is to be arrested by locks, dams, and other works, the principles which have guided the operations of different engineers have been various and contradictory; but, in general, the practice has been to confine the freshes by artificial works, as in the Clyde, Witham, and other rivers, and to preserve the basins, or other receptacles for tidal waters, to their full extent. A contrary proceeding has tended to ruin many rivers and estuaries, and consequently to impede the drainage and navigation in a great degree, and to occasion the destruction of several harbours, such as those of the Dee and Rye. The effects of embankments in Plymouth and Portsmouth harbours, and particularly in the estuary of the Mersey, one third of the ancient capacity of which has been filled up by encroachments, have materially diminished the depths of the sea-channels, and a consequent deterioration of the harbours has been the result.

Where the navigation of a river is impeded by its waters being too much spread, or occupying too wide a channel, this may be remedied by contracting it by embankments, which will have the effect of increasing the depth of the stream, whether it scour out the bottom so as to lower it or not. Such is the usual mode of forming inland navigations in China. It has the advantage of being more speedy than passing through locks, and, indeed, rather too speedy to be safe for vessels in descending. A great power is, in some such cases, required to make a vessel ascend through the contraction. This is accomplished in a variety of ways; often by men aided by capstans; in other cases by machinery, such as a mill being at hand, which may be employed for towing up the vessel, while its weir

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or dam may, besides, be useful in prolonging the navigation of the river considerably farther up.

Improvements on the Rhine.

A splendid example of some of the more recent operations in the management of rivers is to be found in those of M. de Fontaine on the Rhine.[1] Near Emmerik the Waal branches off from the Rhine, so as to form two nearly equal rivers, each of which has its bed almost as large as that of the whole river; and when the waters rise, they are at an equal height in both. The Rhine divides itself again towards Arnheim to form the Issel, which has nearly the same section as the Rhine. The first division of all the waters of this river was begun under the Roman generals Drusus and Corbulo; and many subdivisions were made in subsequent ages. But such a multiplicity of channels, although productive of advantages to Holland, led to many fatal consequences. The waters being so much subdivided, lost the rapidity and strength necessary to push forward the alluvial matter, which being therefore deposited, occasioned a continual rising of the bottom, rendered the drainage of the adjacent lands more difficult, increased the expense of the embankments, and augmented the damages over the extensive lands when the dikes happened to break. The irregularity of the course of the Rhine, and the ravages which it constantly committed on its shores, particularly those of Alsace, one of the most fertile provinces of France, rendered the construction of defensive works imperative; and in 1820 M. de Fontaine was selected to perform this important task. The part of the Rhine to which he principally directed his attention is comprised between Basle and Neuburg, that being the political limit between France and the German states. In this part, the bed of the river is situated in the alluvium which forms the bottom of the valley; and through this the Rhine forces its way by many channels, forming, in its passage, islands and sand-banks, which render its motions very irregular both in times of high and low water. Amongst the different streams there is generally one more considerable than the others, and which forms the navigable channel. These branches are annually diminished by artificial works, and probably in a few years the whole of the waters of the Rhine will be forced into one channel, which may then be expected to become so much deeper, and freer from obstructions, as to be far more fit for navigation.

To enable vessels to ascend a rapid in a river, a powerful though rather tedious method, called warping, has been long in use. This consists in attaching or making fast one end of a rope somewhere up the rapid, and then winding up the other by means of a windlass or capstan on board, till the vessel ascends against the stream. Sometimes a tug-boat in constant attendance at the rapid is provided with two paddle-wheels, one on each side, which, turning by the force of the stream, wind up the rope on their axle, and enable the tug itself not only to ascend the torrent, but also to draw up other vessels after it. This method is probably at least a century old, being described in the *Machines Approuvées par l'Académie des Sciences;* but within the last twenty years it has been repeatedly announced as a wonderful discovery just made, sometimes here and sometimes in America. This shows the importance of diffusing knowledge, to save ingenious men from uselessly wasting their time in re-inventing what is already well known. Sometimes a paddle-wheel stationed somewhere up the rapid winds up the rope, and draws the vessel to it, which we should think by much the better method. Where the navigation of a river is incommoded by shifting mud or sand, the force of the current is sometimes employed, particularly in France, to urge forward a plank held on edge across the stream, so as to make it clear the way like a snow-plough for a fleet of boats, &c. which are to follow. But it is more systematic to have a boat provided with flaps or wings for cleaning a river.

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BRIDGES.

Where canals or rivers are navigated only by such boats as have neither masts nor rigging, the bridges over these waters are, for the most part, fixed, and have scarcely any thing peculiar in them on account of the navigation, except that the arch may rise a little higher, and have a towing-path under it, as shown at B, fig. 8, Plate CCCLXXIX. But a moveable bridge is always employed where a fixed one would occasion too great a rise in a road, or where the arch cannot be elevated sufficiently to clear the masts of vessels. There are several sorts of moveable bridges.

Draw-bridge.

The draw or lift-bridge AA, fig. 8, is one which is fastened with a joint or hinges at one end, so that the other end may be lifted or let down by some easy artifice. Formerly this sort of bridge was lifted and suspended by chains and levers working in a huge wooden frame, which was often of great height, and usually painted in gaudy colours, to the great terror of such horses and other animals as were unaccustomed thereto. Some of these were long to be seen on the Forth and Clyde Canal. But such bridges are now generally lifted, without chains or levers, by turning a pinion which works into a toothed-rack fixed upon the bridge; or, if the bridge is large, it has two of these racks and pinions. This simplification of drawbridges is said to have originated with M. Perronet in France. For small canals a drawbridge consists of one leaf or frame only; but for entrances to docks and harbours, and for large canals, such as that of the Forth and Clyde, it is made in two halves, which meet in the middle when they are shut or let down. Such bridges, however, have been found inconvenient in practice, from their being apt to catch the yards and rigging of vessels in passing through them.

Swing or turn bridge.

This inconvenience has given rise to a different form of moveable bridge, which, instead of lifting, like the former, round a horizontal axis, swings or turns horizontally, as it were, round a vertical axis; but the weight of this bridge is not supported on the centre or axis, but rests and is poised upon a circular series of balls or rollers surrounding the centre of motion. Some of the earliest of these bridges were principally made of wood, and for small canals consisted of a single leaf only; but they are now commonly made of cast iron, and, when large, are double. Fig. 1 shows an elevation, and fig. 2 a plan, of a double bridge of this sort, by the late Mr Ralph Walker, where AA is the line of the roadway, RR the rollers and lower ring, shown separately in fig. 6, with the outer ring to which they are attached. The upper ring is seen in fig. 4. Fig. 5 is a vertical section of the bridge through the centre of the rings, supposing the bridge and building to be laid on their side, and the section to be made across the roadway. In fig. 7, F is a vertical section of the abutment, while E is the upper side of the cross for the pivot, round which either half of the bridge turns. Fig. 3 shows a section of the part of the bridge to which is attached the pinion, which, by working in the fixed segment by means of the handle H, turns either half of the bridge quite out of the way of vessels passing along the river or canal, and also brings it back or shuts it again. GG are holes for putting in pins for locking the bridge. When the bridge is shut, three of the five ribs bear at right angles on the abutments; the other two are secured upon the upper circles, and at GG. We should think that a far

[1] Fontaine, *Des Travaux du Fleuve du Rhin,* 1833; and Mr Rennie's Report on Hydraulics.

more simple bridge of the moveable sort might be formed, so as to move backwards and forwards in a straight line, like a waggon on a railway. Some rude bridges upon this principle are said to have been long in use in China.

BOATS.

Boats formed exclusively for canals are much longer and narrower than those which are also intended for rivers, or for river navigation alone. It is found, that when made of this shape, they are tracked with more ease or speed than when of a wider and shorter form; and they likewise occasion less injury to the sides of the canal. Indeed the proportions of the boats must always be regulated by the dimensions of the locks and bridges; and these have often been made of very reduced width, from considerations of economy in the construction. In the central districts of England, the boats are without masts. They are generally sharp at both ends, having no projecting stern, but being guarded by three rows of wrought-iron bands, which extend round the bows to the distance of twenty feet on each side, above and below the water line. The bottom is nearly flat, but they are generally encumbered with a keel, which is of no use in a canal but to require a greater depth of water. Keels sufficiently heavy, it is true, may act as ballast, but that would not compensate for the other inconvenience. Where very long boats would not have room to turn, several short ones are linked together in a string; one horse drawing these more easily than a single boat of great breadth, which, besides, might not have room to pass through the locks. The boats of the Mersey and Irwell Navigation Company are provided with masts and sails, such that they can coast round the whole island; and they are capable, too, of contending with the most boisterous weather. Their masts are made to strike by means of a forestay attached to two double-sheaved blocks, one of which is firmly fixed to the top of the stem; and the stay is heaved down by a windlass on the forepart of the deck. The boom extends no farther out than the after extremity of the rudder, and the stern is made nearly vertical. Vessels similar to these, especially in having a falling mast to pass under bridges, are much employed on the Thames and other rivers.

Oars, no doubt, in some shape or other, formed at an early period a means of propelling vessels on inland waters, and are still in use for that purpose. Sails, too, are employed on lakes and in the wider parts of rivers, if the current is moderate, with sufficient room for tacking; and during a favourable wind almost all vessels which may, on any account, be provided with sails, are in the habit of hoisting them when on a narrow river or canal. But in the latter cases the most usual method is to track or draw the vessels along by the power of men or horses travelling on the banks. The practice of men tracking boats is probably very ancient, and is still the mode in China and other barbarous or obscure places, where vast numbers of men continue to be thus employed. Nay, to come nearer home, it was even continued on the Thames and the Severn till near the end of last century, when proper towing paths and horses were, for the first time, introduced on these rivers, as they had been long before on canals.

But the most efficient power hitherto employed for propelling vessels, either in still water or against a moderate current in a large river, is that of steam, which has now come into general use for that purpose; though it certainly acts at a prodigious disadvantage, by re-acting against water which it is either leaving or which is moving from it,—a disadvantage, too, which augments with the rate of sailing. For this reason, and on account of the force which is wasted by the paddle-boards in entering and quitting the water with great velocity, and which waste also increases with the velocity of the paddles, it follows that the force of the steam-engine must be greatly increased, to occasion such an increase in the re-action of the paddles as shall urge the vessel with any considerably greater rapidity. Such seem to be some of the reasons why we often hear of a vessel being propelled by a power equal to that of 500 or 600 horses, while there is not the least probability that it is encountering a resistance of one fifth so much.

Of late years a great many experiments have been made on the trackage and resistance of canal-boats, particularly by Mr Palmer, Mr Macniell, and Mr Russell; but their results, though interesting, are very discordant. Mr Palmer makes the resistance as the cube of the velocity, which would be fatal altogether to any thing in the shape of swift boats. Mr Macniell, again, makes the most advantageous velocity about nine or ten miles per hour, which is nearly what has been in use, and found to answer so well for several years with light boats carrying passengers on different canals, as we shall presently notice more particularly. But Mr Russell carries the most advantageous velocity so very high, if indeed he gives it a limit, that, even granting his experiments to be perfectly correct, we have great doubts whether such velocities can ever be applicable to any practical purpose, at least of the nature of a long navigation.

Light boats for conveying passengers with a speed formerly unknown upon canals, were first introduced by Mr Houston, in June 1831, on the Glasgow and Paisley Canal.[1] The following account of its success, after a two years' trial, is given by Mr Thomas Grahame, civil engineer, in his Letter to Canal Proprietors and Traders. "The ordinary speed for the conveyance of passengers on the Ardrossan Canal has, for nearly two years, been from nine to ten miles an hour; and although there are fourteen journeys along the canal per day at this rapid speed, its banks have sustained no injury. The boats are seventy feet in length, about five feet and a half broad, and, but for the extreme narrowness of the canal, might be made broader. They carry easily from seventy to eighty passengers; and, when required, can and have carried upwards of 110 passengers. The entire cost of a boat and fittings up is about L.125. The hulls are formed of light iron plate and ribs, and the covering is of wood and light oiled cloth. They are more airy, light, and comfortable, than any coach. They permit the passengers to move about from the outer to the inner cabin; and the fares per mile are one penny in the first, and three farthings in the second cabin. The passengers are all carried under cover, having the privilege also of an uncovered space. These boats are drawn by two horses, the prices of which may be from L.50 to L.60 per pair, in stages of four miles in length, which are done in from twenty-two to twenty-five minutes, including stoppages to let out and take in passengers, each set of horses doing three or four stages alternately each day. In fact, the boats are drawn through this narrow and shallow canal at a velocity which many celebrated engineers had demonstrated, and which the public believed, to be impossible."

Swift boats have likewise been for several years in use on the Forth and Clyde Canal, the Edinburgh and Glas-

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[1] A small boat closely covered in is by no means free from danger on a deep canal; for if by accident or mismanagement it were allowed to sink, it would be very apt to confine the inmates under water till they were drowned, especially as those who become frantic would prevent the more sober from escaping.

gow Union Canal, the Lancaster Canal, and on various others, with equal success, at least between locks, or wherever they are free from locks. There is, however, little reason to expect, as some seem to do, that any material increase of swiftness above that now described is likely ever to be effected with advantage on ordinary canals. Horses have already been pushed to their utmost speed; and were steam introduced, with all its machinery and apparatus, the weight would be so enormously augmented as to require a prodigious increase of moving power. But, on several other accounts, the ordinary canals, and almost every thing connected with them, are totally unfit for a much greater velocity. Swifter boats would require canals to be interrupted by no locks, to have no contractions at tunnels and bridges, and to be incommoded by no barges or other slow and heavy craft, which cannot instantly be cleared out of the way. Drawbridges would be attended with a similar inconvenience. The slightest covering, even of broken ice, would occasion a serious resistance; whilst intense frost, which has no effect upon railways, arrests boats altogether. The Americans, it is true, pretend to have greatly outstripped us in swiftness; but it is fully as easy to read some of their statements on this head as to give them entire credit. There can be no question that it is easier to propel a boat more speedily along a great river like the Hudson, than in our narrow and shallow canals, where much time is lost in passing through the locks, or great inconvenience is experienced in conveying the cargo from one boat to another, past the locks.

The swiftest boat would take almost the same time to pass through a lock as the most tardy and unwieldy barge; and it would be difficult, and even hazardous, from the risk of striking against the ends of the building, to force it swiftly through, and especially to make it enter a narrow tunnel, or the narrow contractions at bridges or aqueducts. On these accounts, and the perpetual risk of running foul of other craft, the pilotage of a very swift boat is a task with which few could be intrusted, or rather for which no one is competent. These, however, are difficulties and dangers with which railways have not necessarily any thing to do; because the railway itself acts as the most perfect pilot. In short, to think, as some do, that, at this age of the world, canals can ever be brought to compete with railways in point of swiftness, is a project which cannot be listened to by any disinterested person who is sufficiently informed on such subjects.

On the other hand, although the kind of traffic on which canals have hitherto depended principally for their support is not likely to be withdrawn from them by the competition of railways, as appears from the canal business between Liverpool and Manchester having increased since the railway came into operation, yet it is not so easy to quiet the fears of those who are more immediately concerned; and those who do give way to such fears put themselves in the way of being ridiculously imposed upon. Accordingly, a few years ago, a pamphlet was most industriously circulated throughout England, with the view of setting forth the great superiority of canals over railways, and also of showing what a most ruinous speculation the Liverpool and Manchester Railway had been. Such assertions, however, met with a speedy refutation; and, in some discussion which arose on the subject, the author of the pamphlet let out that he had been hired on purpose, and also, what is curious, that his reward was not simply derived from proprietors of coaches and canals, but that one of our great seminaries of religion and learning had liberally afforded him its share of support.

The following is a list of works to which we have either been indebted in drawing up the preceding pages, or at least from which much farther information may still be obtained; though these, after all, form but a small proportion of the works which treat more or less on subjects relating to inland navigation:—Belidor, Architecture Hydraulique; Lalande, Traité des Canaux de Navigation; Frisi, de Canali Navigabili; Phillips' History of Inland Navigation; Fulton on Canal Navigation; Chapman's Observations on Canals, &c.; Leach on Inland Navigation; Anderson's Recreations; Smeaton's Reports on Civil Engineering; Nicholson's Philosophical Journal; Telford's Reports on the Caledonian Canal; Strickland's Reports on Canals, Railways, &c.; Coxe's Travels in the North of Europe; Barrow's Travels in the North of Europe; Transactions of the Society of Civil Engineers; Transactions of Statistical Society; M'Culloch's Commercial Dictionary; M'Culloch's Statistics of the British Empire; Martin's History of the British Colonies; Journal of the Royal Geographical Society; Dupin's Commercial Power of Great Britain; Rennie on Hydraulics, in the Reports of the British Association; Fairbairn on Canal and Steam Navigation; Macniell on the Resistance of Water, &c.; Priestley's Account of Canals, &c. in Britain; Hamilton's East India Gazetteer; Girard, Mémoires sur les Canaux, &c.; Huerne, Des Canaux Navigables; Dutens, Histoire de la Navigation Intérieure de la France; Dutens sur les Travaux Publics d'Angleterre; Warden's Account of the United States of America; Pitkin's Statistics of the United States; Flint's Geography of the Western States; the American Almanac; the Franklin Journal; Mechanics' Magazine; Railway Journal; Edinburgh Philosophical Journal; Edinburgh Review; Balbi, Abrégé de la Géographie; Tableau des Etats Danois, &c. (E. E. E.)

NAVIGATORS' ISLANDS, a group of islands in the Southern Pacific Ocean, remarkable for their extent, fertility, and population. They are about ten in number, and are situated between 169. and 172. 30. west longitude, and from latitude 13. 25. to an uncertain boundary southward. When seen from the ocean they present a lofty appearance, and are mountainous, but neither surrounded with a low border nor enclosed by reefs, like the Society Islands. The first discovery of these islands was made in 1722, by Roggewein and Bauman, who fell in with the easternmost of the number; whilst Bougainville, in 1768, added another; and Perouse, in 1787, discovered the two westernmost, which are the largest, being more than forty miles in length. The last navigator was informed of three more to the southward. The whole group was visited in 1791 by Captain Edwards. The inhabitants are a stout and well-made race, of the ordinary height of five feet nine or eleven inches. They are altogether savage in their manners, which are said to be remarkably profligate and indecent. They are also of the most ferocious dispositions. The least dispute between them is followed by blows from clubs, sticks, or paddles, and is often attended with the loss of life. They are very ingenious, and fashion their work dexterously with hatchets shaped like adzes, and made of very fine and compact basalts. With these they finish works in wood, and give them so high a polish that they appear to be coated with the finest varnish. They also manufacture a species of cloth which possesses great strength and pliability, and is well calculated for the sails of canoes. The name of Navigators' Islands was bestowed by Bougainville, from the practice which prevails amongst the inhabitants of continually travelling in canoes. We have no data upon which we can calculate the amount of the population; but it must be considerable, considering that these islands are amongst the largest and most fertile in the South Seas.

NAVY.

Navy.

An insular empire, like that of the united kingdom of Great Britain and Ireland, which is so much indebted, and always must be, for that power, prosperity, and renown which she enjoys, to the glorious deeds of her navy, cannot but take a peculiar degree of interest in every thing that concerns it. This vast machine, indeed, has at all times been the pride and boast of Great Britain, the terror of its enemies, and the admiration of the world. It is under the impression of its vast importance that we have been induced to give, under their proper heads, such details of the civil and military branches of the naval departments as may afford, without entering into too minute details, a comprehensive sketch of this great national bulwark, of which it is now proposed to take a general view.

The term Navy is generally intended to express all ships of commerce as well as those of war, the mercantile as well as the military marine; but the observations contained in the present article are meant to relate only to the latter, excepting that, in speaking of the progressive enlargement of ships, and improvements in naval architecture, the remarks may sometimes equally apply to ships of commerce and of war.

Navy composed of Materiel and Personel.

The composition of a navy may be considered under the two distinct heads into which it naturally divides itself, and under which the French generally distinguish an army, the *matériel*, and the *personel;* the former embracing every thing that appertains to the ships, their capacity, construction, armament, and equipment; the latter all that concerns the rank, the appointment, the various duties, &c. of the officers, seamen, and marines.

I.—MATERIEL OF THE NAVY.

History.

It would occupy too large a space to give even a short sketch of the origin and the progress of naval architecture, from a bundle of branches, or the hollow trunk of a tree—the rude raft and the frail canoe—to the more perfect coracle, or the wicker-boats of the ancient Britons, covered with hides. For many centuries after the expulsion of the Romans from, or their abandonment of, the British Islands, very little progress appears to have been made by us in the art of navigation or ship building: the natives would appear, for many centuries afterwards, to have acted merely on the defensive against naval invasions.

"The whole of our naval history," say the commissioners for revising the civil affairs of the navy, "may be divided into three periods; the *first* comprehending all that preceded the reign of Henry VIII.; the *second* ending with the restoration of Charles II.; and the *third* coming down from the Restoration to the present day."

First period.

To what size, and to what extent, the amount of the English ships or vessels were carried, which supported so many contests with the invading Danes in the ninth century, our naval history has not preserved any record. We are told, however, that Alfred increased the size of his galleys, and that some of them were capable of rowing thirty pair of oars. These galleys were chiefly employed in clearing the Channel of the nests of pirates by which it was infested. It is also said, as a proof of his attention to naval matters, that, under his auspices, one Ochter undertook a voyage into the arctic regions, made a survey of the coasts of Lapland and Norway, and brought to Alfred an account of the mode pursued by the inhabitants of those countries to catch whales. It is, moreover, on record, that his two sons, Edward and Athelstan, fought many bloody actions with the Danes, in which several kings and chiefs were slain; and that Edgar had from three to five thousand ships, divided into three fleets, stationed on three several parts of the coast, with which, passing from one fleet or squadron to the other, he circumnavigated the island; that after this he called himself "Monarch of all Albion, and Sovereign over all the adjacent Isles." Some notion, however, may be formed of the size of the vessels which composed his fleets, from the imposition of a land-tax, which required certain proprietors to furnish a stout galley of three rows of oars, to protect the coast from the Danish pirates. The more effectually to check these marauders, and protect the coasts of the kingdom, William the Conqueror, in 1066, established the Cinque Ports, and gave them certain privileges, on condition of their furnishing fifty-two ships, with twenty-four men in each, for fifteen days, in cases of emergency. We should not, perhaps, be far amiss in dating the period of our naval architecture from the Conquest. "The Normans," says Sir Walter Raleigh, "grew better shipwrights than either the Danes or Saxons, and made the last conquest of this land; a land which can never be conquered whilst the kings thereof keep the dominion of the seas." But Raleigh does not describe what the ships were which the Normans taught us to build; nor can it now be known in what kind of vessels William transported his army across the Channel, or what was the description of the hundred large ships and fifty galleys of which the naval armament of Richard I. consisted on his expedition to the Holy Land. We are told, however, that having increased his fleet at Cyprus to two hundred and fifty ships and sixty galleys, he fell in with a ship belonging to the Saracens, of such an extraordinary size that she was defended by 1500 men, all of whom, with the exception of 200, Richard, after taking possession of her, ordered to be thrown overboard and drowned. Matériel.

There can be no doubt that the nations of the Mediterranean, particularly the Genoese and Venetians, introduced many improvements as to the capacity and stability of their ships, in consequence of the crusades, and the demands for warlike stores and provisions which such vast and ill-provided armies necessarily created; but these improvements would seem not to have reached, or, at least, to have made but a tardy progress in, Great Britain. King John, it is true, stoutly claimed for England the sovereignty of the sea, and decreed that all ships belonging to foreign nations, the masters of which should refuse to strike to the British flag, should be seized and deemed good and lawful prize. And this monarch is said to have fitted out no less than five hundred sail of ships, under the Earl of Salisbury, in the year 1213, against a fleet of three times that number, prepared by Philip of France for the invasion of England; of which the English took three hundred sail, and drove a hundred on shore, Philip being under the necessity of destroying the remainder, to prevent their falling also into the hands of the English. Of the kinds of ships of which his fleet consisted, some notion may be formed by the account that is related of an action fought in the following reign with the French, who, with "eighty stout ships," threatened the coast of Kent. This fleet being discovered by Hubert de Burgh, governor of Dover Castle, he put to sea with forty English ships, and having got to

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the windward of the enemy, and run down many of the smaller ships, he closed with the rest, and threw on board them a quantity of quicklime, which blinded them so effectually that all their ships were either taken or sunk.

Whatever the size and the armaments of our ships were, the empire of the sea was bravely maintained by the Edwards and the Henrys in many a gallant and glorious sea-fight with the fleets of France, against which they were generally opposed with inferior numbers. The temper of the times, and the public feeling, were strongly exemplified in the reign of Edward I. by the following circumstance: An English sailor was killed in a Norman port, in consequence of which a war commenced, and the two nations agreed to decide the dispute on a certain day, with the whole of their respective naval forces. The spot of battle was to be the middle of the Channel, marked out by anchoring there an empty ship. The two fleets met on the 14th April 1293; the English obtained the victory, and carried off above two hundred and fifty sail.

In an action with the French fleet off the harbour of Sluys, Edward III. is said to have slain 30,000 of the enemy, and to have taken two hundred great ships, "in one of which only, there were four hundred dead bodies." This is no doubt an exaggeration. The same monarch, at the siege of Calais, is stated to have blockaded that port with seven hundred and thirty sail, having on board 14,956 mariners; twenty-five only of which were of the royal navy, bearing four hundred and nineteen mariners, or about seventeen men each. In various other sea actions did this great sovereign nobly support the honour of the British flag. But though we then, and ever after, claimed the "dominion of the seas," that dominion, says Raleigh, "was never absolute until the time of Henry the Eighth." It was a maxim of this great statesman, that "whosoever commands the sea, commands the trade of the world; whosoever commands the trade, commands the riches of the world, and consequently the world itself."

The reign of Henry V., however, was most glorious in maintaining the naval superiority over the fleets of France. From a letter of this sovereign to his lord chancellor, dated 12th August 1417, discovered by the late Mr Lysons among the records in the Tower, and of which the following is a copy, it would appear that there was something like an established royal navy in his reign, independently of the shipping furnished by the Cinque Ports and the merchants, for the king's own use, on occasion of any particular expedition. The letter appears to have been written nine days after the surrender of the castle of Touque in Normandy, from whence it is dated.

"Au reverénd pere en Dieu l'Evesque de Duresme n̄re Chanceller d'Engleterre.

"Worshipful fader yn God We sende you closed within this letter a cedule conteyning the names of certein Maistres for owr owne grete Shippes Carrakes Barges and Balyngers to the whiche Maistres We have granted annuitees such as is appointed upon eche of hem in the same Cedule to take yerely of owre grante while that us lust at owr Exchequer of Westm^r. at the termes of Michelmasse and Ester by even porcions. Wherefore We wol and charge yow that unto eche of the said Maistres ye do make under owr grete seel beyng in yowre warde owr letters patentes severales in due forme after th'effect and pourport of owr said grante. Yeven under owr signet atte owr Castle of Touque the xij. day of August."

Extract from the Schedule contained in the preceding Letter.

vj. li. xiijs. iiijd. La Grande Nief appelle the dont John William est Maistre	vj. Mariners po^r la sauf garde deink Hamult.
vj. li. xiijs. iiijd. La Trinate Royale dont Steph' Thomas est Maistre	vj. Mariners.
vj. li. xiijs. iiijd. La Holy Gost dont Jordan Brownyng est Maistre	vj. Mariners.
vj. li. xiijs. iiijd. La Carrake appellee le Petre dont John Gerard est Maistre	vj. Mariners.
vj. li. xiijs. iiijd, La Carrake appellee le Paul dont William Payne est Maistre	vj. Mariners.
vj. li. xiijs. iiijd. La Carrak appelle le Andrewe dont John Thornyng est Maistr'	vj. Mariners.
vj. li. xiijs. iiijd. La Carrak appellee le Xpōfre dont Tendrell est Maistr'	vj. Mariners.
vj. li. xiijs. iiijd. La Carrak appelle le Marie dont William Richeman est Maistr'	vj. Mariners.
vj. li. xiijs. iiijd. La Carrak appellee le Marie dont William Hethe est Maistre	vj. Mariners.
vj. li. xiijs. iiijd. La Carrak appelle le George dont John Mersh est Maistr'	vj. Mariners.

Matériel.

The remainder, to the masters of which pensions were thus granted, consist of seventeen "niefs, barges, and ballyngers," some with three, and others two mariners only. But history informs us, that about this time Henry embarked an army of 25,000 men at Dover on board of 1500 sail of ships, two of which carried purple sails, embroidered with the arms of England and France; one styled the King's Chamber, the other his Saloon, as typical of his keeping his court at sea, which he considered as a part of his dominions. Still we are left in the dark as to the real dimensions of his ships, and the nature of their armament; they were probably used only as transports for his army. It would appear, however, from a very curious poem, written in the early part of the reign of King Henry VI. that the navy of his predecessor was considerable, but that, by neglect, it was then reduced to the same state in which it had been during the preceding reigns. The poem here alluded to is entitled "The English Policie, exhorting all England to keep the Sea, and namely the Narrow Sea; showing what profit cometh thereof, and also what worship and salvation to England and to all Englishmen;" and is printed in the first volume of Hackluyt's Collection of Voyages. It was evidently written before the year 1438, when the Emperor Sigismond died, as appears by the following passage in the prologue:

For Sigismond, the great Emperour,
Which yet reigneth, when he was in this land,
With King Henry the Fifth, Prince of Honour,
Here much glory, as him thought, he found
A mightie land, which had take in hand
To werre with France, and make mortalitie,
And ever well kept round about the sea.

The part of the poem which alludes to the navy of King Henry V. is entitled "Another incident of keeping the Sea, in the time of marveilous werriour and victorious Prince, King Henrie the Fifth, and of his great Shippes."

The following are the most remarkable passages:

And if I should conclude all by the King
Henrie the Fift, what was his purposing,
When at Hampton he made the great *dromons*,
Which passed other great ships of the Commons;
The *Trinitie*, the *Grace de Dieu*, the *Holy Ghost*,
And other moe, which as nowe be lost.
What hope ye was the Kings great intent
Of thoo shippes, and what in mind he meant:
It was not ellis, but that *he cast to bee*
Lorde round about environ of the see.
And if he had to this time lived here,
He had been Prince named withouten pere:

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His great ships should have been put in preefe,
Unto the ende that he ment of in chiefe.
For doubt it not but that he would have bee
Lord and master about the round see:
And kept it sure, to stoppe our ennemies hence,
And wonne us good, and wisely brought it thence,
That no passage should be without danger,
And his licence on see to move and sterre.

Shortly after the time when this poem must have been written, it appears from the parliament roll (20th Henry VI. 1442), that an armed naval force, consisting only of eight large ships, with smaller vessels to attend them, was to be collected from the ports of London, Bristol, Dartmouth, Hull, Newcastle, Winchelsea, Plymouth, Falmouth, &c.; and, of course, the royal ships of 1417, the names of which are contained in the foregoing schedule, were then either gone to decay or dispersed. We are not to judge of the size of these ships from the few mariners appointed to each. These were merely the ship-keepers, or harbour-duty men, placed on permanent pay, to keep the ships in a condition fit for the sea when wanted.

It is very probable that, until our merchants engaged in the Mediterranean trade, and that the attention of the government was turned, in the reign of Henry VII. (about 1496), to imitate Portugal in making foreign discovery, under the skilful seaman Sebastian Cabot, very little was added to the capacity or the power of British ships of war. It is said, however, that on the accession of Henry VII. to the throne in 1485, he caused his marine, which had been neglected in the preceding reign, to be put into a condition to protect the coasts against all foreign invasions; and that, in the midst of profound peace, he always kept up a fleet ready to act. In his reign was built a ship called the Great Harry, the first on record that deserved the name of a ship of war, if it was not the first exclusively appropriated to the service of the state. This is the same ship which Camden has miscalled the Henry Grace de Dieu, and which was not built till twenty years afterwards, under the reign of Henry VIII. The Great Harry is stated to have cost L.14,000, and was burned by accident at Woolwich in the year 1553.

Second Period.

We now come to that period of our naval history in which England might be truly said to possess a military marine, and of which some curious details have been left us by that extraordinary man of business Mr Pepys, a commissioner of the navy, and afterwards secretary to Charles II., at a time when the king executed in person the office of lord high admiral, and also to James II. until his abdication. His minutes and miscellanies relative to the navy are contained in a great number of manuscript volumes, which are deposited in the Pepysian Library in Magdalene College, Cambridge. From these papers it appears, that in the thirteenth year of Henry VIII. the following were the names and the tonnage of the royal navy:

	Tons.
Henry Grace de Dieu	1500
Gabriel Royal	650
Mary Rose	600
Barbara	400
Mary George	250
Henry Hampton	120
The Great Galley	800
Sovereign	800
Catherine Forteleza	550
John Baptist	400
Great Nicholas	400
Mary James	240
Great Bark	250
Less Bark	180

Add to these two row-barges of sixty tons each, making, in the whole, sixteen ships and vessels, measuring 7260 tons.

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The Henry Grace de Dieu is stated in all other accounts, and with more probability, to have been only 1000 tons; the rule for ascertaining the measurement of ships being still vague, and liable to great error, was probably much more so at this early period. This ship was built in 1515, at Erith, in the river Thames, to replace the Regent, of the same tonnage, which was burned in August 1512, in action with the French fleet, when carrying the flag of the lord high admiral. There is a drawing in the Pepysian papers of the Henry Grace de Dieu, from which a print in the Archæologia has been engraved, and of which a copy has been taken as a frontispiece to Mr Derrick's Memoirs of the Rise and Progress of the Royal Navy. From these papers it appears that she carried fourteen guns on the lower deck, twelve on the main deck, eighteen on the quarter-deck and poop, eighteen on the lofty forecastle, and ten in her stern-ports, making altogether seventy-two guns. Her regular establishment of men is said to have consisted of 349 soldiers, 301 mariners, and fifty gunners, making altogether 700 men. Some idea may be formed of the awkwardness in manœuvring ships built on her construction, or similar to her, when it is stated that, on the appearance of the French fleet at St Helens, the Great Harry, built in the former reign, and the first ship built with two decks, had nearly been sunk; and that the Mary Rose, of 600 tons, with 500 or 600 men on board, was actually sunk at Spithead, occasioned, as Raleigh informs us, "by a little sway in casting the ship about, her ports being within sixteen inches of the water." On this occasion the fleets cannonaded each other for two hours; and it is remarked as something extraordinary, that not less than three hundred cannon-shot were fired on both sides in the course of this action. From the prints above mentioned, which agree very closely with the curious painting of Henry crossing the Channel in his fleet to meet Francis on the Champ de Drap d'Or, near Calais, and now in the great room where the Society of Antiquaries hold their meetings in Somerset House, it is quite surprising how they could be trusted on the sea at all, their enormous poops and forecastles making them appear loftier and more awkward than the large Chinese junks, to which, indeed, they bear a strong resemblance. It is worth remarking, that, two years ago, the position of the Mary Rose, near Spithead, was pointed out to that extraordinary diver Mr Deane, who went down several times, and brought up some beautiful pieces of brass ordnance, as perfect and as fine specimens as any we have at the present day.

Henry VIII. may justly be said to have laid the foundation of the British navy. He established the dock-yards at Deptford, Woolwich, and Portsmouth; he appointed certain commissioners to superintend the civil affairs of the navy, and settled the rank and pay of admirals, vice-admirals, and inferior officers; thus creating a national navy, and raising the officers to a separate and distinct profession. The great officers of the navy then were, the vice-admiral of England, the master of the ordnance, the surveyor of the marine causes, the treasurer, comptroller, general surveyor of the victualling, clerk of the ships, and clerk of the stores. Each of these officers had their particular duties, but they met together at their office on Tower Hill once a week, to consult, and make their reports to the lord high admiral. He also established the fraternity of the Trinity House, for the improvement of navigation and the encouragement of commerce; and built the castles of Deal, Walmer, Sandgate, Hurst Castle, &c. for the protection of his fleet and of the coast.

At the death of Henry VIII. in 1547, the royal navy consisted of about fifty ships and vessels of different sizes, the former from 1000 to 150 tons, and the latter down to twenty tons, making in the whole about 12,000 tons, and manned by about 8000 mariners, soldiers, gunners, &c. In the short reign of his son Edward, little alteration seems to have taken place in the state and condition of the royal navy. But the regulations which had been made in the reign of his father, for the civil government of naval affairs, were revised, arranged, and turned into ordinances, which form the basis of all the subsequent instructions given to the commissioners for the management of the civil affairs of the navy. In the reign of Mary the tonnage of the navy was reduced to about 7000 tons; but her lord high admiral nobly maintained the title assumed by England of Sovereign of the Seas, by compelling Philip of Spain to strike his flag that was flying at the main-top-mast head, though on his way to England to marry Queen Mary, by firing a shot at the Spanish admiral. He also demanded that his whole fleet, consisting of 160 sail, should strike their colours and lower their top-sails, as an homage to the English flag, before he would permit his squadron to salute the Spanish monarch.

The reign of Elizabeth was the proudest period of our naval history, perhaps surpassed by none previously to the Revolution. She not only increased the numerical force of the regular navy, but established many wise regulations for its preservation, and for securing adequate supplies of timber and other naval stores. She placed her naval officers on a more respectable footing, and encouraged foreign trade and geographical discoveries, so that she acquired justly the title of the Restorer of Naval Power, and Sovereign of the Northern Seas. The greatest naval force that had at any previous period been called together was that which was assembled to oppose the Invincible Armada, and which, according to the notes of Mr Secretary Pepys, consisted of 176 ships, with 14,992 men; but these were not all "Shippes Royall," but were partly composed of the contributions of the Cinque Ports and others. The number actually belonging to the navy is variously stated, but they would appear to have been somewhere about forty sail of ships, manned with about 6000 men. At the end of her reign, however, the navy had greatly increased, the list in 1603 consisting of forty-two ships of various descriptions, amounting to 17,000 tons, and manned with 8346 men. Of these, two were of the burden of 1000 tons each, three of 900 tons, and ten from 600 to 800 tons.

James I. was not inattentive to his navy. He warmly patronised Mr Phineas Pett, the most able and scientific shipwright that this country ever boasted, and to whom we undoubtedly owe the first essential improvements in the form and construction of ships. The cumbrous topworks were first got rid of under his superintendence. "In my owne time," says Raleigh, "the shape of our English ships hath been greatly bettered; in extremity we carry our ordnance better than we were wont; we have added crosse pillars in our royall shippes, to strengthen them; we have given longer floors to our shippes than in older times," &c. The young Prince Henry was so fond of naval affairs, that Phineas Pett was ordered by the lord high admiral to build a vessel at Chatham in 1604, with all possible speed, for the young Prince Henry to disport himself in, above London Bridge; the length of her keel was twenty-eight feet, and her breadth twelve feet. In 1610 Pett laid down the largest ship that had hitherto been built. She was named the Prince Royal; her burden was 1400 tons, her keel 114 feet, and she was armed with sixty-four pieces of great ordnance, "being in all respects," says Stowe, "the greatest and goodliest ship that was ever built in England." He adds, "the great workmaster in building this ship was Mr Phineas Pett, gentleman, some time master of arts, of Emanuel College, in Cambridge."

This excellent man, as appears from a manuscript account of his life in the British Museum, written by himself, was regarded by the shipwrights of the dock-yards, who had no science themselves, with an eye of jealousy; and a complaint was laid against him before the king, of ignorance in laying off a ship, and of a wasteful expenditure of timber and other matters. The king attended at Woolwich with his court, to inquire in person into the charges brought forward, and, after a painful investigation, pronounced in favour of Mr Pett. One of the charges was, that he had caused the wood to be cut across the grain; but the king observed, that, as it appeared to him, "it was not the wood, but those who had preferred the charges, that were cross-grained."

The state of the navy at the king's death is variously given by different writers; but on this subject the memoranda left by Mr Secretary Pepys are most likely to be correct. From them it appears that, in 1618, certain commissioners were appointed to examine into the state of the navy, and by their report it appears there were then only thirty-nine ships and vessels, whose tonnage amounted to 14,700 tons; but in 1624, on the same authority, the numbers had decreased to thirty-two or thirty-three ships and vessels, but the tonnage increased to about 19,400 tons. The commissioners had, in fact, recommended many of the small craft to be broken up or sold, and more ships of the higher rates to be kept up.

The navy was not neglected in the troublesome reign of Charles I. This unfortunate monarch added upwards of twenty sail to the list, generally of the smaller kind; but one of them, built by Pett, was of a description, both as to form and dimensions, far superior to any that had yet been launched. This ship was the celebrated Sovereign of the Seas, which was launched at Woolwich in 1637. The length of her keel was 128 feet, the main breadth forty-eight feet, and from stem to stern 232 feet. In the description of this ship by Thomas Heywood, she is said to have "bore five lanthorns, the biggest of which would hold ten persons upright; had three flush-decks, a forecastle, half-deck, quarter-deck, and round-house. Her lower tier had thirty ports for cannon and demi-cannon; middle tier, thirty for culverins and demi-culverins; third tier, twenty-six for other ordnance; forecastle, twelve; and two half-decks, thirteen or fourteen ports more within board, for murthering pieces; besides ten pieces of chace ordnance forward, and ten right aft, and many loop-holes in the cabins for musquet-shot. She had eleven anchors, one of 4400 pounds weight. She was of the burden of 1637 tons." It appears, however, that she was found, on trial, to be too high for a good serviceable ship in all weathers, and was therefore cut down to a deck less. After this she became an excellent ship, and was in almost all the great actions with the Dutch; she was rebuilt in 1684, when the name was changed to that of Royal Sovereign; and was about to be rebuilt a second time at Chatham in 1696, when she accidentally took fire, and was totally consumed. In this reign the ships of the navy were first classed, or divided into six rates, the first being from 100 to sixty guns, the second from fifty-four to thirty-six, &c.

In 1642 the management of the navy was taken out of the king's hands, and in 1648 Prince Rupert carried away twenty-five ships, none of which ever returned; and such, indeed, was the reduced state of the navy, that at the beginning of Cromwell's usurped government, he had only fourteen ships of war of two decks, and some of these carried only forty guns; but, under the careful management of very able men, in different commissions which he appointed, such vigorous measures were pursued, that, in five years, though engaged within that time in war with the greatest naval power in Europe, the fleet was increased to 150 sail, of which more than a third part had two decks, and many of which were captured from the Dutch, and

Matériel. upwards of 20,000 seamen were employed in the navy. Our military marine was, indeed, raised by Cromwell to a height which it had never before reached; but from which it soon declined under the short and feeble administration of his son.

Though Cromwell found the navy divided into six rates or classes, it was under his government that these ratings were defined and established in the manner nearly in which they now are; and it may also be remarked, that, under his government, the first frigate, called the Constant Warwick, was built in England. "She was built," says Mr Pepys, "in 1649, by Mr Peter Pett (son of Phineas), for a privateer for the Earl of Warwick, and was sold by him to the state. Mr Pett took his model of this ship from a French frigate which he had seen in the Thames."

During the first period of our naval history, we know nothing of the nature of the armament of the ships. From the time of Edward III. they might have been armed with cannon, but no mention is made of this being the case. According to Lord Herbert, brass ordnance were first cast in England in the year 1535. They had various names, such as cannon, demi-cannon, culverins, demi-culverins, sakers, mynions, falcons, falconets, &c. What the calibre of each of these was is not accurately known, but the cannon is supposed to have been about sixty-pounders, the demi-cannon thirty-two, the culverin eighteen, falcon two, mynion four, saker five, &c. Many of these pieces, of different calibres, were mounted on the same deck, which must have occasioned great confusion in action in finding for each its proper shot.

Third period.

On the restoration of Charles II. the Duke of York was immediately appointed lord high admiral, and by his advice a committee was named to consider a plan, proposed by himself, for the future regulation of the affairs of the navy, at which the duke himself presided. By the advice and able assistance of Mr Pepys, great progress was speedily made in the reparation and increase of the fleet. The duke remained lord high admiral till 1673, when, in consequence of the test required by parliament, to which he could not submit, he resigned, and that office was in part put in commission, and the rest retained by the king. Prince Rupert was put at the head of this commission, and Mr Pepys appointed secretary to the king in all naval affairs, and of the admiralty; and by his able and judicious management there were in sea-pay, in the year 1679, and in excellent condition, seventy-six ships of the line, all furnished with stores for six months, eight fireships, besides a numerous train of ketches, smacks, yachts, &c. with more than 12,000 seamen; and also thirty new ships building, and a good supply of stores in the dock-yards. But this flourishing condition of the navy did not last long. In consequence of the dissipation of the king, and his pecuniary difficulties, he neglected the navy on account of the expenses; the duke was sent abroad, and Mr Pepys to the Tower. A new set of commissioners were appointed, without experience, ability, or industry; and the consequence was, as stated by the commissioners of revision, that "all the wise regulations formed during the administration of the Duke of York were neglected; and such supineness and waste appear to have prevailed, that, at the end of not more than five years, when he was recalled to the office of lord high admiral, only twenty-two ships, none larger than a fourth rate, with two fire-ships, were at sea; those in harbour were quite unfit for service; even the thirty new ships which he had left building had been suffered to fall into a state of great decay, and hardly any stores were found to remain in the dock-yards."

The first act on the duke's return was the re-appointment of Mr Pepys as secretary of the admiralty. Finding the present commissioners unequal to the duties required of them, he recommended others. Sir Anthony Deane, the most experienced of the shipbuilders then in England, was joined with the new commissioners. To him, it has been said, we owe the first essential improvement in the form and qualities of ships of the line, having taken the model of the Superbe, a French ship of seventy-four guns, which anchored at Spithead, and from which he built the Harwich in 1664. Others, however, are of opinion that no improvement had at this time been made on the model of the Sovereign of the Seas after she was cut down. The new commissioners undertook, in three years, to complete the repair of the fleet, and furnish the dock-yards with a proper supply of stores, on an estimate of L.400,000 a year, to be issued in weekly payments; and in two years and a half they finished their task, to the satisfaction of the king and the whole nation; the number of ships repaired and under repair being 108 sail of the line, besides a considerable number of vessels of smaller size. The same year the king abdicated the throne, at which time the list of the navy amounted to 173 sail, containing 101,892 tons, carrying 6930 guns, and 42,000 seamen.

The naval regulations were wisely left unaltered at the Revolution, and the business of the admiralty continued to be carried on chiefly, for some time, under the immediate direction of King William, by Mr Pepys, till the arrival of Admiral Herbert and Captain Russell from the fleet, into whose hands, he says, "he silently let it fall." Upon the general principles of that system, thus established with his aid by the Duke of York, the civil government of our navy has ever since been carried on.

In the second year of King William (1690), no less than thirty ships were ordered to be built, of sixty, seventy, and eighty guns each; and in 1697 the king, in his speech to parliament, stated that the naval force of the kingdom was increased to nearly double what he found it at his accession. It was now partly composed of various classes of French ships which had been captured in the course of the war, amounting in number to more than sixty, and in guns to 2300; the losses by storms and captures on our side being about half the tonnage and half the guns we had acquired. At the commencement of this reign, the navy, as we have stated, consisted of 173 ships, measuring 101,892 tons; at his death, it had been extended to 272 ships, measuring 159,020 tons, being an increase of ninety-nine ships and 57,128 tons, or more than one half both in number and in tonnage.

The accession of Queen Anne was immediately followed by a war with France and Spain, and in the second year of her reign she had the misfortune of losing a vast number of her ships, by one of the most tremendous storms that was ever known; but every energy was used to repair this national calamity. In an address of the House of Lords, in March 1707, it is declared as "a most undoubted maxim, that the honour, security, and wealth of this kingdom does depend upon the protection and encouragement of trade, and the improving and right encouraging its naval strength......therefore we do in the most earnest manner beseech your majesty, that the sea affairs may always be your first and most peculiar care." In the course of this war were taken or destroyed about fifty ships of war, mounting 3000 cannon; and we lost about half the number. At the death of the queen, in 1714, the list of the navy was reduced in number to 247 ships, measuring 167,219 tons, being an increase in tonnage of 8199 tons.

George I. left the navy pretty nearly in the same state in which he found it. At his death, in 1727, the list consisted of 233 ships, measuring 170,862 tons, being a decrease in number of fourteen, but an increase in tonnage of 3643 tons.

George II. was engaged in a war with Spain in 1739, in consequence of which the size of our ships of the line

Matériel. ordered to be built was considerably increased. In 1744, France declared against us; but on the restoration of peace in 1748, it was found that our naval strength had prodigiously increased. Our loss had been little or nothing, whilst we had taken and destroyed, of the French twenty, and of the Spanish fifteen sail of the line, besides smaller vessels. The war with France of 1755 added considerably to the list, so that, at the king's decease, in 1760, it consisted of 412 ships, measuring 321,104 tons.

In the short war of 1762, George III. added no less than twenty sail of the line to our navy. At the conclusion of the American war in 1782, the list of the navy was increased to 600 sail; and at the signing of the preliminaries in 1783 it amounted to 617 sail, measuring upwards of 500,000 tons; being an increase of 185 ships and 157,000 tons and upwards since the year 1762. At the peace of Amiens the list of the fleet amounted to upwards of 700 sail, of which 144 were of the line. The number taken from the enemy, or destroyed, amounted nearly to 600, of which ninety were of the line, including fifty-gun ships, and upwards of two hundred were frigates; and our loss amounted to about sixty, of which six were of the line and twelve frigates.

The recommencement and long continuance of the revolutionary war, and the glorious successes of our naval actions; the protection required for our extended commerce, of which, in fact, we might be said to enjoy a monopoly, and for the security of our numerous colonies; contributed to raise the British navy to a magnitude to which the accumulated navies of the whole world bore but a small proportion. From 1808 to 1813, there were seldom less than from 100 to 106 sail of the line in commission, and from 130 to 160 frigates, and upwards of 200 sloops, besides bombs, gun-brigs, cutters, schooners, &c. amounting in the whole to about 500 sail of effective ships and vessels; to which may be added 500 more in the ordinary, and as prison, hospital, and receiving ships; making at least 1000 pendants, and measuring from 800,000 to 900,000 tons. The commissioners appointed to inquire into the state and condition of the woods, forests, and land revenues of the crown, state, in their report to parliament, in the year 1792, that, "at the accession of his majesty (Geo. III.) to the throne, the tonnage of the royal navy was 321,104 tons, and at the end of the year 1788 it had risen to no less than 413,467 tons." In 1808 it had amounted to the enormous extent of 800,000 tons, having nearly doubled itself in twenty years.

It must not, however, be supposed that the effective navy consisted of more than half this amount of tonnage. Since the conclusion of the war, it would appear that at least one half of the number of ships then in existence have been sold or broken up as unfit for the service; and as, by the list of the navy at the beginning of the year 1821, the number of ships and vessels of every description, in commission, in ordinary, building, repairing, and ordered to be built, has been reduced to 609 sail, we may take the greatest extent of the present tonnage at 500,000 tons; but the greater part, if not the whole, of this tonnage may be considered as efficient, or in a state of progressive efficiency. Matériel.

According to the printed list of the 1st January 1821, the 609 sail of ships and vessels appear to be as under:

			No.
1st Rates	from 120 to	100 guns	23
2d Rates	... 86 ...	80 do	16
3d Rates	... 78 ...	74 do	90
4th Rates	... 60 ...	50 do	20
5th Rates	... 48 ...	22 do	107
6th Rates	... 34 ...	24 do	40
Sloops	... 22 ...	10 do	136
		Making a total of	432
To which being added, gun-brigs, cutters, schooners, tenders, bombs, troop-ships, store-ships, yachts, &c.			177
		Grand total	609

In the year 1836 the total number of ships of war, including every description mentioned in the above list, amounted to about 560 sail; of which ninety-five were ships of the line in a state of efficiency for any service, or of being speedily put into a fit state for sea, and many of them of a very superior class to any employed in the last war.

The increase in the size of our ships of war was unavoidable; France and Spain had increased theirs, and we were compelled, in order to meet them on fair terms, to increase the dimensions of ours; many of theirs were, besides, added to the list of our navy. The following sketch will show the progressive rate at which ships of the first order, or of 100 guns and upwards, were enlarged in their dimensions. In 1677 the first rates were from 1500 to 1600 tons. In 1720 they were increased to 1800 tons. In 1745 we find them advanced to 2000 tons. During the American war they were raised to 2200 tons. In 1795 the Ville de Paris, of 110, measured 2350 tons. In 1804 the Hibernia, of 110 guns, was extended to 2500 tons; and in 1808 the Caledonia, carrying 120 guns, measured 2616 tons, and here we stopped; but since then, the Nelson, the Howe, the St Vincent, the Britannia, the Prince Regent, the Royal George, and the Neptune, have been built, or are building, all nearly of the same dimensions, and from the same draught—nine such ships as the whole world besides cannot produce. The French had one ship larger than any of these, called the Commerce de Marseilles. She was taken by us in Toulon, but broke her back in a gale of wind.

The following are the comparative dimensions of the Caledonia and the Commerce de Marseilles.

	Length of Gun-deck.		Length of Keel.		Extreme Breadth.		Depth of Hold.		Tons.
	feet.	in.	feet.	in.	feet.	in.	feet.	in.	
Caledonia	205	0	170	9	53	8	23	2	2616
Commerce de Marseilles	208	4	172	0	54	9½	25	0½	2747

The following is the armament of the Caledonia: On the gun-deck she carries thirty-two guns, 32-pounders; middle-deck thirty-four 24-pounders, upper deck thirty-four 24-pounders, carronades; quarter-deck ten 32-pounders, and six 12-pounders, carronades; forecastle two 32-pounders, and two 12-pounders, carronades. Her complement of men is 875.

At the commencement of the *third period*, we have a somewhat more precise account of the armament of our ships of war. On the 16th of May 1677, a committee of the navy board, ordnance, and certain naval officers, recommended to his majesty the following scheme for arming and manning the thirty new ships of the line ordered to be built by act of parliament.

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Guns.	1st Rates.	2d Rates.	3d Rates.
Cannon (supposed 42 prs.).	No. 26	...	...
Demi-cannon (32 prs.).......	...	26	26
Culverins (18 prs.)..........	28	26	...
Twelve-pounders....	...	...	26
Sakers, upper-deck..........	28	26	...
... Forecastle...........	4	...	4
... Quarter-deck........	12	10	10
Three-pounders	2	2	4
	100	90	70

For the 1st rate......................780 men.
For the 2d do.........................660 do.
For the 3d do.........................470 do.

The rates of ships immediately after the revolution were reduced, the first being turned to second rates, the second rates to third, &c, and the size of each class more equalized. But from this time forward it was found impossible to preserve any thing like uniformity in the several classes. So many ships captured from the French, Dutch, and Spaniards, were added to our navy, and so many new ones built after the models of ships taken from these maritime powers, that the various descriptions of ships of which our navy was composed became a very serious evil.

In the year 1745, a committee, composed of all flag-officers unemployed, of the commissioners of the navy who were sea-officers, under the presidency of Sir John Norris, and assisted by the master shipwrights, were ordered to meet, to consider and propose proper establishments of guns, men, masts, yards, &c. for each class of his majesty's ships; and, according to their recommendation, the rates, armaments, and complements of his majesty's ships were to be as follows:

Rate.	Guns.	Men.
1	100	850 or 750
2	90	750 or 660
3	80	650 or 600
	70	520 or 460
4	60	420 or 380
	50	350 or 280
5	44	280 or 220
6	24	160 or 140

But this establishment was very soon departed from; for, on the 3d of February 1747, the board of admiralty acquainted his majesty, that the French ship Invincible, lately captured, was found to be larger than his majesty's ships of ninety guns and 750 men; and suggested that this ship, and all other prizes of the like class, and also his majesty's ships of ninety guns, when reduced to two decks and a half, and seventy-four guns, should be allowed a complement of 700 men. And it further appears, that, at the latter end of the reign of George II. the rates of ships had undergone a very material alteration, for they consisted as under:

1st Rate.........100 guns.
2d Rate..........90 guns.
3d Rate..........80 guns, 74—70—64 guns.
4th Rate..........60 guns, 50.
5th Rate..........44 guns, 38—36—32 guns.
6th Rate..........30 guns, 28—24—20 guns.

The scales for measuring the ships were as various as their rates; and the evil was further increased by the varieties which it was found necessary to introduce in the rigging and arming of the ships of war. The masts, yards, rigging, and stores, were of so many and various dimensions, as to be not only highly inconvenient, but extremely expensive. When Lord Nelson was off Cadiz with seventeen or eighteen sail of the line, he had no less than *seven* different classes of seventy-four gun ships, each requiring different sized masts, sails, yards, &c. so that, in the event of one of these being disabled, the others could not supply her with such stores as could be appropriated to her wants.

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Present Rating of the Navy.

To remedy the many inconveniences resulting from the irregularities above mentioned, the lords of the admiralty suggested, by their memorial to the prince regent, which, by his order in council, of the 25th November 1816, was ordered to be carried into effect, that the ships of the navy should for the future be rated as under.

The first rate to include all three-deckers, in as much as all sea-going ships of that description carry a hundred guns and upwards.

The second rate to include all ships of eighty guns and upwards, on two decks.

The third rate to include all ships of seventy guns and upwards, but less than eighty guns.

The fourth rate to include all ships of fifty and upwards, but less than seventy guns.

The fifth rate to include all ships from thirty-six to fifty guns.

The sixth rate to include all ships from twenty-four to thirty-six guns.

And that the complements of men be established as under.

1st Rate.............900 — 850 or 800 men.
2d Rate.............700 or 650.
3d Rate.............650 or 600.
4th Rate.............450 or 350.
5th Rate.............300 or 280.
6th Rate.............175 — 145 or 125.

Of sloops, the complements established according to their size were to consist of 135, 125, 95, or 75 men; of brigs (not sloops), cutters, schooners, and bombs, sixty or fifty men.

Thus stands the rating and manning of the navy at present; but another war, or a new administration of the affairs of the navy, will, in all human probability, make new regulations in these respects. It is, however, of the utmost importance, with a view to convenience and economy, that the size and dimensions of the several rates should be kept as nearly as possible equal, in order that one description of stores may be applicable to every ship of the same rate. To this end, the commissioners of naval revision have recommended, "that the ships of each class or rate should be constructed, in every particular, according to the form of the best ship in the same class in our navy; of the same length, breadth, and depth; the masts of the same dimensions, and placed in the same parts of the ship, with the same form and size of the sails." A complete classification of masts, yards, and sails, has very recently been established.

Improvements in Construction.

If we look back to the days of Elizabeth, when the chain-pump, the capstan, the striking of the top-masts, the studding-sails, top-gallant-sails, sprit-sails, &c. were first introduced into the navy, one can scarcely conceive how they contrived to keep the sea for any length of time; but these improvements, important as they were, are trifling when compared with those aids and conveniences which have gradually been introduced since her reign, and which a ship of war now enjoys. When Sir Anthony Deane, in 1664, raised the lower ports of a two-decker four and a half feet out of the water, which had before been scarcely three feet, and made a ship of this class to stow six months' provisions instead of three, it was justly considered as a

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most important improvement; not less so, when the breadth of a ship of this class was carried to forty-five feet. "The builders of England," says Pepys, "before 1673, had not well considered that breadth only will make a stiff ship." It must be confessed, however, that, as far as the form of a ship's bottom depends on scientific principles, we have copied our best models from the French, sometimes with capricious variations, which more frequently turned out to be an injurious alteration than an improvement.

The first essential alteration in the form of our ships of the line was taken from the Superbe, a French ship of seventy-four guns, which anchored at Spithead, on the model of which, as already stated, the Harwich was built by Sir Anthony Deane in 1674; since which time we have constantly been copying from French models, improving or spoiling, as chance might determine. "Where we have built exactly after the form of the best of the French ships that we have taken," say the commissioners of naval revision, "thus adding our dexterity in building to their knowledge in theory, the ships, it is generally allowed, have proved the best in our navy; but whenever our builders have been so far misled by their little attainments in the science of naval architecture, as to depart from the model before them in any material degree, and attempt improvements, the true principles on which ships ought to be constructed (being imperfectly known to them) have been mistaken or counteracted, and the alterations, according to the information given to us, have, in may cases, done harm." Whilst, therefore, they add, "our rivals in naval power were employing men of the greatest talents and most extensive acquirements, to call in the aid of science for improving the construction of ships, we have contented ourselves with groping on in the dark in quest of such discoveries as chance might bring in our way."

Upon these grounds, and by the recommendation of the commissioners, a school for a superior class of shipwright apprentices was established in Portsmouth dockyard. It consisted of twenty-five young men of liberal education, whose mornings were passed in the study of mathematics and mechanics, and in their application to naval architecture; and the remainder of the day under the master shipwright in the mould loft, and in all the various kinds of manual labour connected with ship-building, as well as in the management and conversion of timber, so as to make them, at the same time, fully acquainted with all the duties in detail of a practical shipwright. After producing more officers than could be provided for, it was deemed expedient to break up the establishment.

If, however, we have hitherto been inferior to the French in the scientific principles of ship-building, in the constructive part we have left them behind beyond all comparison; and, notwithstanding the narrow prejudices which have been more remarkably adhered to among shipwrights than among almost any other class of artisans, various alterations and improvements have from time to time been introduced into the mechanical part of naval architecture, which have added to the strength, the stability, the comfort, and convenience of our ships of war, and rendered them, in every point of view, superior to those of any other nation. The application of iron where wood was formerly used, and of copper for iron, has added considerably to the durability of ships; and the sheathing of their bottoms with copper, to their celerity; giving them, at the same time, a protection against the worm and those marine insects which were wont to adhere to them; yet it is remarkable how strong the prejudice was against this practice before it obtained a due degree of credit. In the fleet of Sir Edward Hughes in India there was but one coppered ship, and Rodney's squadron in the West Indies had but four that were coppered in the year 1799; but these were enough so completely to establish their superiority over the others with wooden sheathing, that, in the year 1782, the whole British navy was coppered.

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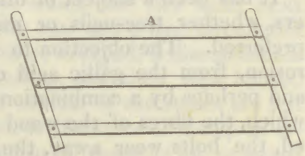
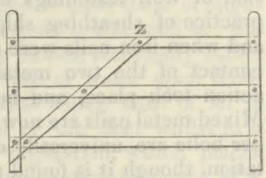
System of diagonal bracing.

But the greatest of all improvements in the construction of ships of war, as tending to their strength and durability, is the system of diagonal bracing, introduced a few years ago by Mr (afterwards Sir Robert) Seppings, surveyor of the navy, and now universally adopted in all ships of the line and frigates; a system that may be said to have established a new era in naval architecture. Of all large machines destined to undergo severe shocks, a ship is perhaps the least skilfully and artificially contrived. Her several parts are put together on a principle so much opposed to that which constitutes strength, that if a ship, on the old construction, should be put upon wheels, and drawn over a rough pavement, the action of a day would shake her in pieces; but being destined to move in an element that closes upon her, and presses her equally on all sides, she is prevented from falling in pieces outwards, and her beams and decks preserve her from tumbling inwards. Whoever has observed a ship *in frame*, as it is called, on the stocks, that is, with only her timbers erected, must be forcibly reminded of the skeleton of some large quadruped, as of a horse or ox, laid on its back; the keel resembling the back-bone, and the curved timbers the ribs, which is, in fact, the name by which they sometimes go. These ribs, issuing at right angles from the keel, consist, in a seventy-four gun ship, of about 800 different pieces, the space between each rib seldom exceeding five inches. These ribs are covered with a skin or planks of different thicknesses within and without, also at right angles to the ribs, and fixed to them by means of wooden pins or tree-nails. In the inside three or four tiers of beams cross the skeleton from side to side, at right angles to both planks and ribs. These beams support the decks. At right angles to the beams are pieces of wood called carlings, and at right angles to these other pieces called ledges, and upon these the planks of the deck are laid in a direction at right angles to the beams, and parallel to the planking of the sides. From this sketch it will be perceived that all the parts of a ship are either parallel or at right angles to each other. The ribs form a right angle with the keel, the planks inside and out are at right angles to the ribs, the beams at right angles to these, the carlings to the beams, the ledges to the carlings, and the planks of the decks to the ledges, the beams, and the ribs.

Now, it is well known to every common carpenter, that this disposition of materials is the weakest that can be adopted. Thus, if five pieces of wood be pinned together in the shape of a parallelogram, it will require but little force to move them from the rectangular to the oblique or rhomboidal shape. But place a cross-bar, as in the figure Z, as carpenters are accustomed to do on a common gate, and it is no longer moveable on the points of fastening.





The strongest proof of a ship's partaking of this weakness in the old construction, is afforded on her being first launched into the water, when it is invariably found that the two extremities, being less water-borne than the middle, drop, and give to the ship a convex curvature upwards, an effect which, from its resemblance to the shape of a hog's back, is usually called *hogging*. In very weak or old ships this effect may be discovered in all the port-holes of the upper-deck, by their having taken the shape of lozenges, declining different ways from the centre of the ship to each extremity.

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To obviate this great defect, Seppings tried the experiment of applying to the ribs or timbers of the ship, from one extremity to the other, and from the orlop-deck downwards to the kelson, that well-known principle in carpentry, called *trussing;* being, in fact, a series of diagonal braces disposing themselves into triangles, the sides of which give to each other a mutual support and counteraction. These triangles were firmly bolted to the frame; and in order to give a continuity of strength to the whole machine, and leave no possible room for play, he filled the spaces between the frames with old-seasoned timber cut into the shape of wedges; but afterwards with a prepared cement, thus rendering the lower part of the ship or floor one solid, complete mass, possessing the strength and firmness of a rock; but a few years have proved that this cement has injured the timber.

The same principle of trussing is carried from the gundeck upwards, from whence, between every port, is introduced a diagonal brace, which completely prevents the tendency of ships to stretch, or draw asunder their upper works. The decks, too, are made subservient to the securing more firmly the beams to the sides of the ship, by the planks being laid diagonally in contrary directions, from the midships to the sides, and at an angle of forty-five degrees with the beams, and at right angles with the ledges.

In frigates and smaller vessels, iron plates, lying at an angle of forty-five degrees with the direction of the trusses, are substituted for the diagonal frame of wood in ships of the line.

By this mode of construction, the ceiling or internal planking is wholly dispensed with, and a very considerable saving of the finest oak timber thereby effected; and, what is more important, those receptacles of filth and vermin between the timbers, which were before closed up by the planking, are entirely got rid of. This is not the least important part of the improvement, either as it concerns the soundness of the ship or the health of the crew. It is stated that a ship which had been three years in India, on being laid open, exhibited a mass of filth, mixed up with dead rats, mice, cockroaches, and other vermin, which was taken out in cakes, not unlike in appearance the oil-cake with which certain animals are fed; that the stench was abominable, and the timbers with which it was in contact rotten. No such filth can find a lodgment in ships of war as they are now built.

Fastenings.

It has been a subject of discussion amongst ship-builders, whether tree-nails or metallic fastenings are to be preferred. The objection to iron bolts is their rapid corrosion, from the gallic acid of the wood, the sea-water, and perhaps by a combination of both; in consequence of which, the fibres of the wood around them become injured, the bolts wear away, the water oozes through, and the whole fabric is shaken and disarranged. This corrosion of iron fastenings was most remarkable when the practice of sheathing ships with copper became general, and when iron nails were made use of to fix it; for, by the contact of the two metals in the sea-water, a galvanic action took place, and both were immediately corroded. Mixed metal nails are now used for this purpose; and copper bolts are universally employed below the line of flotation, though it is found that in these also oxidation takes place to a certain degree, and causes partial leaks. Various mixtures of metals have been tried, but all of them are considered as liable to greater objections than pure copper. It would appear, then, that tree-nails, if properly made, well seasoned, and driven tight, are the least objectionable, being seldom found to occasion leaks, or to injure the plank or timbers through which they pass. This species of fastening has at all times been used by all the maritime nations of Europe. The Dutch were in the habit of importing them from Ireland, it being supposed that the oak grown in that country was tougher and stronger than any which could be procured on the Continent, and in all respects best adapted for the purpose. "Under all circumstances," says Mr Knowles, "it appears that the present method of fastening ships generally with tough, well-seasoned tree-nails, with their ends split, and caulked after being driven, and securing the buts of each plank with copper bolts well clenched, is liable to fewer objections, and more conducive to the durability of the timber, than any other which has been tried or proposed to be established."

Round bows to ships of the line.

The rounding the form of the bow in ships of the line is considered by nautical men as of great utility and importance. The plan was first proposed by Seppings in 1807, and has since been generally adopted. The removal of the head railing, and the continuing of the rounded form, give not only great additional strength to the ship, but also much more comfort and convenience to the crew, and security in that part of the ship when in action.

Scarphing a substitute for compass timber.

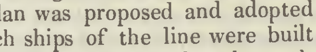
The scarcity of compass or crooked timber was, for some time, attended with serious injury to those ships of war while on the stocks, into which it was considered necessary to be introduced. The difficulty with which it was procured, the length of time which a ship sometimes remained on the stocks waiting for a few pieces of compass timber, the green wood, when found, being immediately added to the seasoned timber in other parts of the frame, gave to the ship different periods of durability; though, in the long run, the seasoned parts became affected by the green wood with which they were in contact, and a premature decay of the whole fabric was the consequence. Seppings, therefore, proposed a plan in 1806, which, by uniting short timbers according to a method called *scarphing,* enabled him to obtain every species of compass-form that could be required from straight timber. Since that period, the whole frame of a ship can be prepared at once, without waiting for particular pieces, and thus every part of it can be made to undergo an equal degree of seasoning.

Plan for rendering frigate timber applicable to ships of the line.

By the same ingenious and indefatigable surveyor of the navy, a plan was proposed and adopted in the year 1813, by which ships of the line were built with timber hitherto considered as applicable only to the building of frigates, and that which had been deemed only fit for inferior uses was appropriated to principal purposes. The Talavera was the first ship built on this principle, and the expense of her hull is stated to have been about a thousand pounds less than that of the Black Prince, a ship of similar dimensions built upon the old principle. The method by which the timbers were united was found, on trial of the Talavera with the Black Prince, whilst in frame, to give so much additional strength to the former, that it furnished the groundwork of the present mode of framing the British navy, by the introduction of the same union of materials in the application of the large, as was practised in that of the small timber, and from which both strength and economy have been united.

Use of chocks abolished.

The building of the Talavera, and the great strength of her frame, led to the practice of putting together the frames of ships of the line from timbers of reduced lengths, and dispensing altogether with the chocks used for uniting their extremities, or, as they are technically called, their heads and heels. These chocks are of the form of an obtuse wedge, as A, and they are used to unite the two pieces of timber, as B and C, by firmly bolting the piece A to the two timbers B and C.



It generally happened, however, that, in the operation of thus fixing this chock, its two extremities split, and the surfaces of the chock and timbers not being in perfect contact, the moisture and air were admitted, and occasioned, as they always do, the dry rot to a greater degree in those parts of the ship than in most others; and as there were from four to five hundred of these chocks in a seventy-four gun ship, it will readily be conceived what mischief was done to the whole fabric, if the greatest care was not taken by the workmen to prevent their splitting, and to bring their surfaces immediately into contact. It is obvious, also, that a great deal of timber must have been cut to waste in making these chocks; and, in fact, they consumed timber in each ship, when it was at a high price, to the value of from L.1500 to L.2000, besides a considerable expense in workmanship; and when the ship came to be repaired, not one chock in six was found to be in a fit state to be used again. It is not easy to conceive how this practice of uniting the timbers of a ship's frame came to be introduced so generally into the British navy, more especially as it is unknown in any other nation; it was probably first done to preserve the length of some particular timbers, one of whose ends might be defective, and the unsound part cut away in the manner we see it, and the sound chock introduced to fill up the vacuity; but it is quite surprising how a practice should have become general which creates a waste of timber, an increase of workmanship, and sows the seeds of premature decay. To obviate these disadvantages, Sir Robert Seppings brought the but-ends of the timbers together thus,

and kept them together by means of a round dowal or coak, as C, just as the fellies of a carriage-wheel are fastened together. He justly observes, that the simplicity of the workmanship, the economy in the conversion of timber, and the greater strength and durability, although of considerable moment, are of but trifling importance when compared with the advantage of rendering timber generally more applicable to the frames of ships, which had heretofore been but partially so.

Another great improvement in the construction of ships of war, introduced by Seppings, is the round stern, which, however unsightly it may at first appear, from being accustomed to view the square stern with its grotesque carved work, is even in appearance more consistent with the termination of the sweeping lines of a ship's bottom, than the cutting them off abruptly with a square stern. But the additional strength which is thus given to a ship in that part which was hitherto the weakest, is alone sufficient to recommend the adoption of the plan in our ships of war, particularly in those of the larger classes. The advantages gained by circular sterns are thus enumerated by Sir Robert Seppings.

1. They give additional strength to the whole fabric of a ship.

2. They afford additional force in point of defence.

3. They admit of the guns being run out in a similar way to those in the sides.

4. From the circular form and mode of carrying up the timbers, an additional protection against shot is obtained, if the ship should be raked.

5. The stern being equally strong as the bow, no serious injury can accrue in the event of the ship being pooped; and the ship may be moored, if so required, by the stern.

6. A ship will sail better upon a wind, from the removal of the projections of the quarter galleries.

7. Ships of the line have now a stern-walk, protected by a veranda, and so contrived that the officers can walk all round, can observe the set of the sails, and the fleet in all directions.

8. The compass-timber heretofore expended for transoms is substituted with straight timber, and worked nearly to a right angle, which affords a considerable saving in the consumption of timber.

9. The counter being done away by the circular stern, the danger which arose from boats being caught under it is obviated.

In fact, the circular stern possesses many other advantages not necessary to be enumerated in this place.

Improvements in the Preservation of the Navy.

Not only is the new mode of construction highly favourable to the duration of ships, but the ravages of the disease which is known by the name of the dry rot, occasioned principally by the hurry in which ships were built in the course of the late war, and the unseasoned state of the timber made use of (see DRY ROT), led to such measures as tend most effectually to the preservation of the fleet.

By prevention of dry rot.

In the first place, various modes were put in practice for assorting and seasoning the timber, and for protecting it from the vicissitudes of the weather. The oak and fir of Canada, which had been introduced to a great extent into our dock-yards during the time the Baltic was shut against this country, are now excluded; these woods having been found not only to possess little durability, but so friendly to the growth of fungi, that they communicated the baneful disease to all other descriptions of timber with which they came in contact. The practice of building ships under cover, introduced into our dock-yards in the course of the war, and carried to an extent so as to have roofed over almost every dock and slip in all the yards, has been destructive to the growth of dry rot. See DOCK-YARDS.

By precautions in ordinary.

A ship now placed in ordinary, whether new or newly repaired, is carefully housed over, so that no rain can reach her lower decks; several streaks of planks are removed from her sides and decks to admit a thorough draft of air, which is sent down by wind-sails, and which pervades every part of the ship; and these, with the addition of two small airing-stoves, in which a few cinders are burned, render her perfectly dry and comfortable on all the decks and store-rooms. All the shingle ballast is removed out of the hold, which is thoroughly cleaned and restowed with iron ballast. The former practice of mooring two ships together, by which the two sides next to each other, deprived of the sun and a free circulation of air, were generally found to be decayed, is discontinued. The lower masts are left standing, and their tops housed over; the gun-carriages and several of the stores are left on board; and such, in short, is the state of a ship in ordinary, that she may be fitted in all respects for proceeding to sea in half the usual time. "The ships," says Mr Knowles, "are frequently pumped to clear them of bilge-water, and cleanliness in every respect is attended to; the lower decks are rubbed with dry stones, commonly called holly-stones, and with sand, the use of water upon them being strictly forbidden." But that which most of all is likely to insure the preservation of the fleet whilst in a state of ordinary, is the recent regulation, which places the ordinary under the immediate superintendence of a captain at each port, with other commissioned officers under his orders, who take care that the warrant-officers and ship-keepers attend to the proper airing, ventilating, and keeping clean and dry their respective ships.

By immersion of timber in salt-water.

A practice has recently been introduced into the dock-yards, of steeping oak timber in salt-water for several months, and then stacking it till it becomes perfectly dry, which is said to have entirely put a stop to the progress of dry rot where it had already commenced, and to act as a

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By roofing the ships. Next to the system of diagonal braces, the roofing thrown over them whilst building and in ordinary may be considered as the greatest of all improvements for the preservation of the navy. The utility of it is so obvious, that it is quite extraordinary such a practice should not have been earlier adopted; more especially as, at Venice, at Carlscrona, and at Cronstadt, ships of war had long been built, repaired, and protected under covered roofs. It was strongly recommended to the English ship-builders fifty years ago, but without effect; and had it not been for the extraordinary ravages of the dry rot in the unseasoned timber-built ships of the navy, we should still have been without roofs to our docks and slips.

By other means. If the dock-yards were of sufficient capacity, there can be no doubt that the efficient plan to accomplish their durability, would be that of keeping them on the slip, when built, under cover. A large frigate, the Worcester, has remained on the slip and under cover for six or seven years, and there is not a flaw in her of any kind. It was stated by Mr Strange, when examined by the commissioners for land revenue, that in the year 1790 there were twenty-two ships of the line under roofs in the port of Venice, some of which had remained in that situation fifty-nine years. Since, however, it is utterly impracticable to keep our navy on slips, or in dry docks, the next important consideration is, how best to preserve them afloat in a state of ordinary. Various expedients have been at different times resorted to in order to prevent the premature decay of ships laid up in this state during peace. The two great requisites for their preservation are ventilation and cleanliness. To promote the former, wind-sails were in general use, though, if not attended to, so as to oppose the open part to the quarter from whence the wind blows, or if the weather be calm, they are of little benefit. Pneumatic machines of various kinds, as pumps and bellows, have been applied to force out the foul air, and introduce atmospherical air into the lower parts of a ship's hold. Heated air from stoves, placed in various parts of the ship, and conducted through tubes, was thought at one time to be efficacious in the preservation of the navy; but experience soon showed that the heat thus circulated was so far objectionable, as it tended to encourage the growth of fungus where there was any moisture lodged, and in the timber which had not been thoroughly seasoned. Perhaps no better means can be suggested than those we have described to be in practice, namely, to keep them clean, to admit as much dry air as possible, and to exclude all moisture.

Finally, if we take into consideration the numerous improvements which a war, unparalleled in its duration, has been the means of introducing into the *matériel* of the navy, whether it regards the economy of its application, the construction of the ships, and their mode of preservation, we may safely say, that at no former period was this country in possession of such a navy as at present, in respect of the number, size, and good condition of the ships which compose a fleet, superior to those of the whole world besides; and it is gratifying to find, that, with all the enormous consumption of the military and mercantile navy, it does not appear that the naval resources of Great Britain are at all impaired.

Naval Resources.

It is of essential importance that the supply of stores for the use of the fleet should not only be adequate to the demand, but that a sufficient stock should be kept on hand to answer any sudden emergency. This is the more necessary with regard to those species of stores which are derived from foreign nations.

Principal naval stores. The principal articles of consumption required for building and equipping a fleet are, hemp, canvass, pitch, tar, iron, copper, and timber. All these articles might unquestionably be produced in sufficient quantities in the united kingdom and her colonies, if necessity absolutely

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required it. Hemp, for instance, might be grown to any extent in Great Britain and Ireland, were not the land more advantageously employed in raising other articles of consumption, and if it could not be cheaper imported from Russia. In the East Indies, the Sunn hemp (inferior, it is true, to Russia hemp) might be procured to any extent; and other plants, both there and at home, might be substituted for the making of cordage and canvass. For pitch and tar, recourse might be had to the pitch-lake on the island of Trinidad, and the coal-tar, of which an inexhaustible supply may be had at home. The lake is about four miles in circumference, and many feet in depth, of solid pitch; and it is stated that, when mixed with oil or tallow, it is rendered fit for all the purposes to which pitch and tar are usually applied. It has the advantage of securing ships' bottoms against the attack of the worm, which is very active in the neighbouring Gulf of Para; and it does not corrode iron. The coal-tar of home manufacture, from some prejudice or other, was refused a fair trial till very lately, and it is now deemed not inferior for many purposes to the common tar. For painting or tarring over wood-work of every kind, it is said to stand exposure to the weather even better than the common tar; and it is used for injecting in large quantities between the timbers of ships, as a preservative from the dry rot; its powerful smell having also the good effect of driving rats and other vermin out of the ships on which it is employed,

Pitch and tar.

Copper and iron.

In the two important articles of copper and iron, our own resources may be considered as inexhaustible. Formerly it was deemed indispensable that certain articles should be made of Swedish iron, but of late years our own has been manufactured in every respect equally good; and the extensive application of this metal in bridges, barges, dock-gates, roofs, rafters, floors, &c. has been equally progressive in most naval purposes. Iron knees, and other modes of binding the beams to the side timbers of ships, are now substituted for those large and crooked pieces of timber which were once deemed absolutely necessary. Our cables, rigging, buoys, and tanks for holding water, are also now of iron.

Timber.

But the most important article of demand for the use of the navy is timber, principally oak, concerning the supply of which from our own territories different opinions have been entertained. A deficiency in other articles may readily be supplied. A failure in the importation of hemp, for instance, in any one year, might be remedied the next, by an extended cultivation of that article; but it requires a whole century to repair any defalcation of oak timber, and to render us independent of other nations. Nor has the subject been sufficiently elucidated, so as to form a just opinion, by the several committees of the House of Commons, the evidence produced being almost always loose, and generally contradictory. The committee of 1771, which was directed to inquire into the state of oak timber throughout the kingdom, either from a disagreement of opinion, or defect of evidence, or a wish to avoid giving alarm, prayed the house to discharge that part of its order which required them to report their opinion. The commissioners of woods and forests, however, in their report laid before parliament in 1792, appeared to establish the fact of an alarming scarcity of oak timber in general, but more particularly of large naval timber, both in the royal forests and on private estates. And if such was really the fact in 1792, it will readily be conceived what the state of timber fit for naval purposes must have been at the conclusion of the revolutionary war, when the amount of private shipping had increased from 1,300,000 tons to 2,500,000 tons, or nearly doubled; that of the East India Company, in the same period, from 79,900 tons to 115,000 tons; and that of the navy from 400,000 to 800,000 tons: to say nothing of the vast consumption of oak timber in all kinds of mill-work and other machinery; in the barrack and ordnance departments; in mines, collieries, and agriculture; in docks and dock-gates; in piers, locks, and sluices; in boats, barges, lighters, bridges, and a great many other purposes to which this timber is applied. From these, and many other causes, the diminution of oak timber was infinitely greater than the commissioners had calculated upon, and yet they recommended that 100,000 acres, belonging to the crown, should be set apart and planted, as necessary for the future supply of the navy. A bill to this effect, relating to the New Forest, passed the Commons, but was thrown out by the Lords.

Report of the commissioners of land revenue respecting timber.

On the departments of the surveyor-general of the land revenue and the surveyor-general of the woods and forests being united, the board of commissioners made their first report, which was printed, by order of the House of Commons, in June 1812. In this report, it is stated that, taking the tonnage of the navy in 1806 at 776,087 tons, it would require, at one and a half load to a ton, 1,164,085 loads to build such a navy; and supposing the average duration of a ship to be fourteen years, the annual quantity of timber required would be 83,149 loads, exclusive of repairs, which they calculate would be about 27,000 loads, making in the whole about 110,000 loads; of which, however, the commissioners reckon, may be furnished 21,341 loads as the annual average of prizes; and of the remaining 88,659 loads, they think it not unreasonable to calculate on 28,659 from other sources than British oak. "This," they observe, "leaves 60,000 loads of such oak as the quantity which would be sufficient annually to support, at its present unexampled magnitude, the whole British navy, including ships of war of all sorts, but which may be taken as equivalent together to twenty 74-gun ships, each of which, one with another, contains about 2000 tons, or would require, at the rate of a load and a half to the ton, 3000 loads, making just 60,000 loads for twenty such ships."

Quantity of timber required for the navy.

Now it has been supposed that not more than forty oak trees can stand on an acre of ground, so as to grow to a full size, fit for ships of the line, or to contain each a load and a half of timber; 50 acres, therefore, would be required to produce a sufficient quantity of timber to build a 74-gun ship, and 1000 acres for twenty such ships; and, as the oak requires at least 100 years to arrive at maturity, 100,000 acres would be required to keep up a successive supply for maintaining a navy of seven or eight hundred thousand tons. The commissioners further observe, that as there are twenty millions of acres of waste lands in the kingdom, a two-hundredth part set aside for planting would at once furnish the whole quantity wanted for the use of the navy.

This calculation, we suspect, is overrated by about one half. In the first place, it supposes a state of perpetual war, during which the tonnage of the whole navy is considered as more than double of what it now actually is; and, in the second place, it reckons the average duration of the navy at fourteen years only, which, from the improvements that have taken place in the construction and preservation of ships of war, with the resources of teak ships, built in India, we should not hesitate in assuming at an average of twice that number of years; and if so, the quantity of oak required for the navy will be nothing like that which the commissioners have stated. This, we think, will appear from a statement made (apparently on good authority) in the midst of the war, when the ships of the line built in merchants' yards were falling to decay after a service of five or six years.

"Assuming 400,000 tons as the amount of tonnage to be kept in commission, and the average duration of a ship of war at the moderate period of twelve and a half years,

Matériel.

there would be required an annual supply of tonnage, to preserve the navy in its present effective state, of 32,000 tons; and as a load and a half of timber is employed for every ton, the annual demand will be 48,000 loads. The building of a 74-gun ship consumes about 2000 oak trees, or 3000 loads of timber, so that 48,000 loads will build eight sail of the line and sixteen frigates. Allowing one fourth part more for casualties, the annual consumption will be about 60,000 loads, or 40,000 full-grown trees, of which thirty-five will stand upon an acre of ground. The quantity of timber, therefore, necessary for the construction of a 74-gun ship will occupy fifty-seven acres of land, and the annual demand will be the produce of 1140 acres. Allowing only ninety years for the oak to arrive at perfection, there ought to be now standing 102,600 acres of oak plantations, and an annual felling and planting, in perpetual rotation, of 1140 acres, to meet the consumption of the navy alone. Large as this may seem, it is little more than twenty-one acres for each county in England and Wales; which is not equal to the belt which surrounds the park and pleasure-grounds of many estates."

The above calculation proceeds upon the principle that every acre is covered with trees fit for naval purposes, or that it contains thirty-five trees, with a load and a half of timber in each. It may be doubted, however, if, on the average of plantations, we shall find more than one tenth of that number on an acre; and as the same writer endeavours to show that the quantity of oak timber consumed in the navy is only about one tenth part of the whole consumption of the country, instead of 102,600 acres being sufficient for a perpetual supply, there would be required some ten or twelve millions of acres, in plantations similar to those at present existing, to supply the demand for oak timber. Whether such a quantity exists or not, the fact is certain, that, long before the conclusion of the war, a scarcity began to be felt, especially of the larger kind of timber, fit for building ships of the line; and so great was this scarcity, that if Sir Robert Seppings had not contrived the means of substituting straight timber for those of a certain form and dimension, before considered as indispensable, the building of new ships must have entirely ceased.

If, however, the growth of oak for ship timber was greatly diminished during the war, so as to threaten an alarming scarcity, there is little doubt that, from the increased attention paid by individuals to their young plantations, and the great extension of those plantations, as well as from the measure of allotting off portions of the royal forests to those who had claims on them, and enclosing the remainder for the use of the public, this country will, in future times, be fully adequate to the production of oak timber equal to the demand for the naval and mercantile marine. It will require, however, large and successive plantations, on account of the slow growth of the oak. But there is another tree, of late years very generally planted on rising grounds, which bids fair to become an object of great national importance, as furnishing the best, and perhaps the only, substitute for oak timber. We mean the larch, which thrives well and grows rapidly in bad soils and exposed situations, the timber of which has been found to be durable, and, from several experiments, not inferior in strength, toughness, and elasticity to oak. So rapid is its growth, that the Duke of Atholl received twelve guineas for a single larch fifty years old; the timber was valued at two shillings a foot. A larch of seventy years' growth produces timber fit for all naval purposes, and may be considered as equal in size to an oak of double that age. The dimensions of a larch tree cut down at Blair Atholl in 1817, and then seventy-nine years of age, were as follows: viz. stem, eighty-two feet; top, twenty feet; total height, 102 feet; girth at the ground, twelve feet; at nineteen feet, eight feet three inches and a half; and at fifty-seven feet, four feet ten inches; solid contents, 252·8 cubic feet. Another larch, growing at Dunkeld, measured, in the year 1819, when it was eighty years old, and in full vigour, as follows, viz. height of stem seventy-five feet, top fourteen feet; total height ninety feet: at one foot from the ground, seventeen feet eight inches in girth; at ten feet, ten fect four inches; and at seventy feet, three feet two inches; its contents, 300 cubic feet, or six loads. For all kinds of mill-work, as wheels, axle-trees, &c. the utility of the large larch wood is unquestionable; and the thinnings are excellent for pailing, rails, and hurdles. The value of its application for naval purposes has been put to the test of experiment; two frigates of twenty-eight guns, one built entirely of larch from the Duke of Atholl's plantations, the other of Riga fir (which is inferior only to oak), having been intended to go through the same service, precisely in the same parts of the world, in order to ascertain their comparative durability.

Indian teak.

In addition to our resources of naval timber at home, we have wisely availed ourselves of those which India affords for building ships of war at Bombay, of teak, a wood far superior in every respect to oak, and many times more durable; not liable to corrode iron or other metallic fastenings, not susceptible of the dry rot, nor subject to the attack of the worm.

II.—PERSONEL OF THE NAVY.

Personel.

The *personel* of the navy is composed of two different bodies of men, the seamen and the marines, each of whom have their appropriate officers.

Commissioned officers.

The commissioned officers of the former consist of flag-officers, captains, commanders, and lieutenants. Flag-officers are divided into three ranks, and each rank into three squadrons, distinguished by the colours red, white, and blue; as admiral of the red, white, or blue; vice-admiral of the red, white, or blue; rear-admiral of the red, white, or blue; the admiral wearing his colour at the main, the vice-admiral at the fore, and the rear-admiral at the mizen-mast head. There is also an admiral of the fleet, who, if in command, would carry the union flag at the main. There are besides superannuated rear-admirals, enjoying the rank and pay of a rear-admiral, but incapable of rising to a higher rank on the list. There is also in the navy the temporary rank of commodore, who is generally an old captain, and is distinguished by wearing a broad pendant. He ranks next to the junior rear-admiral, and above all captains, except where the captain of the fleet shall be a captain, who, in that situation, takes rank next to the junior rear-admiral.

The commissioned officers of the navy take rank with those of the army as follows.

Navy.	Army.
Admiral of the fleet.	Field-marshal.
Admiral.	General.
Vice-admiral.	Lieutenant-general.
Rear-admiral.	Major-general.
Commodore.	Brigadier-general.
Captain of three years.	Colonel.
Captain under ditto.	Lieutenant-colonel.
Commander.	Major.
Lieutenant.	Captain.

And all officers of the same rank command according to the priority of their commissions, or, having commissions of the same date, according to the order in which they stand on the list of the officers of the navy, except in the case of lieutenants of flag-ships, who take precedence according as the flag-officer shall think fit to appoint them.

The warrant-officers of the navy may be compared with

Personel. the non-commissioned officers of the army. They take rank as follows, viz. master, second master, gunner, boatswain, carpenter. There are other warrant-officers of the navy, who, though non-combatants, constitute a part of the establishment of the larger classes of ships of war. These are, the chaplain, surgeon, surgeon's assistant, purser; to which may be added, as part of the staff of a fleet or squadron, secretary to the admiral or commander-in-chief, and physician to the fleet. In steam-vessels, the engineers rank next after the warrant-officers.

Warrant-officers.

Petty officers.

The petty officers are very numerous, the principal of whom are masters' mates and midshipmen. Their names or ratings will be seen in the table of the establishment of the ratings and pay in the several classes of ships of war.

Order of promotion.

By the king's order in council, the following regulations are established for the promotion of commissioned officers of the navy. Midshipmen are required to serve six years on board some of his majesty's ships, two of which years they must have been rated as midshipmen, to render them eligible to the rank and situation of lieutenant.

No lieutenant can be promoted to the rank of commander until he has been on the list of lieutenants during two years; and no commander to the rank of captain until he has been on the list for one year. Captains become admirals in succession according to their seniority on the list, provided they shall have commanded four years in a rated ship during war, or six years during peace, or five years in war and peace combined.

No person can be appointed to serve as master of one of his majesty's ships who shall not have served as second master; and no person can be appointed as second master until he has passed such examination as may from time to time be directed.

No person can be appointed gunner or boatswain unless he shall have served one year as a petty officer on board one or more of his majesty's ships, and produce certificates of his good conduct, and undergo the necessary examination.

No person can be appointed carpenter unless he shall have served an apprenticeship to a shipwright, and been six months a carpenter's mate on board one or more of his majesty's ships.

No person can be appointed purser, unless he shall have been rated and discharged the duties of a captain's clerk for two complete years, one year as captain's clerk, and been employed in the office of the secretary to a flag-officer for one other year, produce good certificates, and find such security for the honest and faithful discharge of his duty as shall be required.

No person can be appointed chaplain to one of his majesty's ships until he has received priest's orders; but he may be appointed to act whilst in deacon's orders.

No person can be appointed surgeon to one of his majesty's ships until, by long and meritorious services, he has discharged the duties of assistant surgeon; and all persons applying for the situation of assistant surgeon must undergo an examination touching their qualifications before the physician general of the navy.

Royal marines.

The royal marines consist of four great divisions; the first stationed at Chatham, the second at Portsmouth, the third at Plymouth, and the fourth at Woolwich. They are composed of seventy-two companies, besides two companies of royal marine artillery, whose head-quarters are at Fort Monckton, Gosport. The first division has twenty-one companies; the second, eighteen companies; the third, twenty companies; and the fourth, thirteen companies. The officers of royal marines take rank with the officers of the line in the army.

A colonel commandant, who is a general officer in the corps, is resident in London; and to each of the divisions is a colonel commandant, two lieutenant-colonels, and two majors, with a proper number of captains and subaltern officers. Whilst on shore, the marines are subject to the same regulations as the army; but when embarked, they are liable to the naval articles of war.

Each division has its paymaster, a captain in the corps; a barrackmaster, also a captain; two adjutants, and a quartermaster, who are first lieutenants; and to each division is a surgeon and an assistant surgeon. There is also a retired list of officers, who, in consideration of wounds, infirmities, and long and meritorious services, are permitted to receive their full pay.

The commissions of officers of every rank in the marine corps are signed by the sovereign; but all commissions of officers of the navy are signed by two or more of the lords commissioners of the admiralty. But the marines, whether ashore or afloat, are, as well as the officers of the navy, under the immediate direction and control of the lords commissioners of the admiralty. All the appointments of commissioned and warrant officers to ships are made exclusively by the lords of the admiralty, or made subject to their confirmation, unless in cases of the death or dismissal of officers by sentence of court-martial on foreign stations, when the admiral commanding has the power to fill up the vacancies. And the duties of each rank are pointed out in a code of instructions emanating from that board, and sanctioned by the sovereign's order in council.

Military duties of the lord high admiral.

The civil powers and duties of the lord high admiral, or lords commissioners of the admiralty, are treated of under the article ADMIRAL. Their military powers are more extensive and important. By their orders all ships are built, repaired, fitted for sea, or laid up in ordinary, broken up, or sold; put in commission or out of commission, armed, stored, and provisioned; and employed on the home or foreign stations. All appointments or removals of commission and warrant officers, with the exception of masters and surgeons, are made by them, and all instructions issued for the guidance of their commanders; all promotion in the several ranks emanates from them; all honours bestowed for brilliant services, and all pensions, gratuities, and superannuations for wounds, infirmities, and long services, are granted on their recommendation. All returns from the fleet are sent to the board of admiralty, and every thing that relates to the discipline and good order of every ship. All orders for the payment of naval monies are issued by the lords commissioners of the admiralty; and the annual estimate of the expenses of the navy is prepared by them, and laid before parliament for its sanction. All new inventions and experiments are tried by their orders before being introduced into the service; all draughts of ships must be approved by them; all repairs, alterations, and improvements in the dock-yards, and all new buildings of every description, must be submitted for their decision before they are undertaken.

Commander-in-chief.

All flag-officers, commanders-in-chief, are considered as responsible for the conduct of the fleet or squadron under their command. They are bound to keep them in perfect condition for service; to exercise them frequently in forming orders of sailing and lines of battle, and in performing all such evolutions as may occur in the presence of an enemy; to direct the commanders of squadrons and divisions to inspect the state of each ship under their command, to see that the established rules for good order, discipline, and cleanliness, are observed, and occasionally to inquire into these and other matters themselves. They are required to correspond with the secretary of the admiralty, and report to him all their proceedings, for the information of the board.

If a commander-in-chief should be killed in battle, his flag is to be continued flying, and intelligence conveyed, by signal or otherwise, to the next in command, who is immediately to repair on board, leaving his own flag (if a

Personel.

flag-officer) flying, and direct the operations of the fleet until the battle be ended, or the enemy out of sight.

Other flag-officers.

Every flag-officer serving in a fleet, but not commanding it, is required to superintend all the ships of the squadron or division placed under his orders; to see that their crews are properly disciplined; that all orders are punctually attended to; that the stores, provisions, and water, are kept as complete as circumstances will admit; that the seamen and marines are frequently exercised; and that every precaution is taken for preserving the health of their crews; for all which he is responsible to the commander-in-chief. When at sea, he is to take care that every ship in his division preserve her station, in whatever line or order of sailing the fleet may be formed; and in battle he is to observe attentively the conduct of every ship near him, whether of the squadron or division under his immediate command or not; and at the end of the battle he is to report it to the commander-in-chief, in order that commendation or censure may be passed, as the case may appear to merit; and he is empowered to send an officer to supersede any captain who may misbehave in battle, or whose ship is evidently avoiding the engagement. If any flag-officer be killed in battle, his flag is to be kept flying, and signals to be repeated, in the same manner as if he were still alive, until the battle shall be ended; but the death of a flag-officer, or his being rendered incapable of attending to his duty, is to be conveyed as expeditiously as possible to the commander-in-chief.

Captain of the fleet.

The captain of the fleet is a temporary rank, where a commander-in-chief has ten or more ships of the line under his command; it may be compared with that of adjutant-general in the army. He may either be a flag-officer, or one of the senior captains; in the former case, he takes his rank with the flag-officers of the fleet; in the latter, he ranks next to the junior rear-admiral, and is entitled to the pay and compensation of a rear-admiral. All orders of the commander-in-chief are issued through him, and all returns of the fleet are made through him to the commander-in-chief. He is appointed and can be removed from his situation only by the lords commissioners of the admiralty.

Commodore.

A commodore is a temporary rank, and of two kinds; the one having a captain under him in the same ship, and the other without a captain. The former has the rank, pay, and allowances of a rear-admiral, the latter such additional pay as the lords of the admiralty may direct. They both carry distinguishing pendants.

Captain.

When a captain is appointed to command a ship of war, he commissions the ship by hoisting his pendant; and if fresh out of the dock, and from the hands of the dock-yard officers, he proceeds immediately to prepare her for sea, by demanding her stores, provisions, guns, and ammunition, from the respective departments, according to her establishment. He enters such men as may volunteer and be fit for the service (in time of peace), or which may be sent to him from some rendezvous for raising men in time of war; and he gives them the several ratings of petty officers, able seamen, ordinary, or landsmen, as their apparent qualifications may entitle them to. If he be appointed to succeed the captain of a ship already in commission, he passes a receipt to the said captain for the ship's books, papers, and stores, and becomes responsible and accountable for the whole of the remaining stores and provisions; and, to enable him to keep the ship's accounts, he is allowed a clerk of his own appointing.

The duty of the captain of a ship, with regard to the several books and accounts, pay-books, entry, musters, discharges, &c. is regulated by various acts of parliament; but the state of the internal discipline, the order, regularity, cleanliness, and the health of the crews, will depend mainly on himself and his officers. In all these respects, the general printed instructions for his guidance are particularly precise and minute. And, for the information of the ship's company, he is directed to cause the articles of war, and abstracts of all acts of parliament for the encouragement of seamen, and all such orders and regulations for discipline as may be established, to be hung up in some public part of the ship, to which the men may at all times have access. He is also to direct that they be read to the ship's company, all the officers being present, once at least in every month. He is not authorized to inflict any corporal punishment on any commissioned or warrant officer, but he may place them under arrest, and suspend any officer who shall misbehave, until an opportunity shall offer of trying such officer by a court-martial. He is enjoined to be very careful not to suffer the inferior officers, or men, to be treated with cruelty or oppression by their superiors. He alone is to order punishment to be inflicted, which he is never to do without sufficient cause, nor ever with greater severity than the offence may really deserve, nor until twenty-four hours after the crime has been committed, which must be specified in the warrant ordering the punishment; and all the officers and the whole ship's company are to be present at every punishment, which must be inserted in the log-book, and an abstract at the end of every quarter made out and sent to the admiralty; a regulation which is said to have been attended with infinite benefit to the strict and just discipline of the naval service.

Lieutenant.

The lieutenants take the watch by turns, and are at such times intrusted, in the absence of the captain, with the command of the ship. The one on duty is to inform the captain of all occurrences which take place during his watch, as strange sails that may be in sight, signals from other ships in company, change of wind, &c. He is to see that the ship be properly steered, the log hove, and the course and distance entered on the log-board; and, in short, he is to see that the whole of the duties of the ship are carried on with the same punctuality as if the captain himself were present. In the absence of the captain the senior lieutenant is responsible for every thing done on board.

Master.

The master receives his orders from the captain, or any of the lieutenants. His more immediate duties are those of stowing the ship's hold, and of attending to her sailing qualities; of receiving and placing the provisions in the ship, so as most conveniently to come at those which may be wanted. He is to take care that the cables are properly coiled in the tiers. The keys of the spirit-room are in his custody, and he is directed to intrust them only to the master's mates. He has the charge of the store-rooms of the warrant-officers, which he is ordered frequently to visit; in short, the whole of the ship's provisions, water, fuel, and stores of every description, are under the superintendence of the master; and he is also intrusted, under the command of the captain, with the charge of navigating the ship, bringing her to anchor, ascertaining the latitude and longitude of her place at sea, surveying harbours, and making such nautical remarks and observations as may be useful and interesting to navigation in general.

The warrant-officers are charged with the duty of receiving on board from the dock-yards, and examining, the various stores of their respective departments, and keeping an account of the expenditure of them.

Gunner.

The gunner has the charge of the ship's artillery, and of the powder magazine. He is to see that the locks and carriages are kept in good order, and that the powder is preserved from damp; he is frequently to examine the musquetry and small arms, and to see that they are kept clean and fit for service; and, in preparing for battle, it is his duty to take care that all the quarters are supplied with every thing necessary for the service of the guns, and, Personel. during the action, that there be no want of ammunition served out. He is frequently to exercise the men at the guns, and to see that they perform this part of their duty with correctness, explaining and enforcing the necessity of their pointing the guns before they fire them, spunging them well, and close-stopping the touch-hole immediately after firing. The armourer and his mates are under the immediate orders of the gunner, in every thing that relates to the great guns and small arms.

Boatswain. The boatswain is charged with the duty of receiving and examining all the stores belonging to his department, consisting chiefly of the ropes and rigging, the latter of which he is ordered to inspect daily, in order that any part of it, chafed or likely to give way, may be repaired without loss of time. He is always required to be on deck at such times as all hands are employed; he is bound to see that the men, when called, move quickly upon deck, and when there, that they perform their duty with alacrity, and without noise or confusion. The sail-maker and the rope-maker are under his immediate orders; and he is directed to see that both these officers perform their respective duties with diligence and propriety.

Carpenter. The carpenter, when appointed to a ship, is carefully to inspect the state of the masts and the yards, whether in the dock-yard or on board of the ship, to see that they are perfectly sound and in good order. He is to examine every part of the ship's hull, magazine, store-rooms, and cabins. He is every day when at sea carefully to examine into the state of the masts and yards, and to report to the officer of the watch if any appear to be sprung, or in any way defective. He is to see that the ports are secure and properly lined, and that the pumps are kept in good order, as also the boats, ladders, and gratings. The caulker is placed under his immediate orders, and he is to see that the former performs his duty in a workmanlike manner, in stopping immediately any leaks that may be discovered in the sides or decks.

Purser. The purser has the charge of all the ship's provisions, and of the serving them out for the use of the crew. His charge is, therefore, of a most important nature; and, accordingly, he must not only produce good certificates of his conduct whilst serving in the capacity of clerk, but must also find two sureties for the due discharge of his trust, who are required to give bond in a penal sum, according to the rate or class of ship to which he may be appointed. The regulations and instructions for his guidance are minutely detailed in the general printed instructions, with all the various forms established for the keeping of his accounts with the comptroller of victualling, to whom he is immediately responsible. To assist him in the performance of his arduous duties, he is allowed to employ the clerk, who, being engaged by the captain, who is responsible for the strict performance of the duties of all the officers under his orders, is, as it were, a check on the purser in many parts of his duty, regarding the slop-books, muster-books, &c. He has also a steward under his immediate orders.

Physician. The duties of the physician to the fleet, the surgeon of a ship and his assistants, the secretary to the commander-in-chief, and the chaplain, are too obvious to require any specification.

Midshipmen. The midshipmen are considered as the principal petty officers, but have no specific duties assigned to them. In the smaller vessels, some of the senior ones are intrusted with the watch; they attend parties of men sent on shore; pass the word of command on board, and see that the orders of their superiors are carried into effect; and, in short, are exercised in all the duties of their profession, so as, after six years' service, to qualify them to become lieutenants.

Marines. Every ship, according to her class, has a certain number of marines serving on board as part of her complement. They are commanded by a captain, or brevet-major, in from first to fourth rates inclusive, with three or two subalterns under them, and an established number of non-commissioned officers; but the party on board fifth rates, and under, is commanded by a subaltern, and in small vessels by a sergeant or corporal.

All marine-officers, of whatsoever rank, when embarked, are to obey the orders of the captain, or the commanding officer of the watch. The marines are exercised by their officers in the use of their arms; they are employed as sentinels, and in all other duties on board of which they are capable, with the exception of going aloft. The officer commanding has the charge of the arms, accoutrements, and drums; and he is to inspect weekly, at least, the state of the clothing of his party. The marines are in every respect treated in the same manner as the rest of the ship's company.

Number of commissioned officers. The long continuance of the revolutionary war necessarily created a prodigious increase of the commissioned officers of the navy. Their numbers, in the five following years of peace, were,

	1793.	1803.	1815.	1821.	1836.
Admirals..........	11	45	70	63	43
Vice-admirals.....	19	36	73	59	59
Rear-admirals....	19	51	77	68	63
Captains............	444	666	824	828	755
Commanders......	160	410	762	776	823
Lieutenants........	1408	2461	3211	3797	2976

The warrant-officers have increased in each class, from the average of about 400 in 1793, to 700 in 1821.

The number of seamen and marines voted in 1792 was 16,000 (but never reduced to that number); in 1822, it was 21,000; and in 1836, 32,000. The greatest number of seamen and marines voted in any one year during the war was 150,000.

Ship's company. The crew of a ship of war consists of able seamen, ordinary seamen, landsmen, boys, and marines. The landsmen, boys, and marines, are always entered voluntarily, the latter in the same manner as soldiers, by enlisting into the corps, the two former at some rendezvous, or on board particular ships. A supply of boys for the navy is also regularly sent from the Asylum at Greenwich and the Marine Society. Able and ordinary seamen also very commonly volunteer to serve during the war, and always in time of peace; but the high wages given by the merchant ships to seamen in time of war hold out such encouragement as to induce them to give the preference to that service, though, in all other respects, their treatment is far superior on board a king's ship, having better provisions, and being subject to much less fatigue and exposure to the weather. Indeed, the excellent regulations now rigidly adhered to on board his majesty's ships, and the attention that is paid to the health and comfort of the crew, have overcome much of that reluctance which formerly was felt to the service of a ship of war.

Health of the crew. The state of health on board of a king's ship is, generally speaking, not exceeded in the most favoured spot on shore; and that horrible disease, the sea-scurvy, may now be considered as unknown in the British navy, since the universal introduction of lemon juice, or the citric acid, without an ample supply of which no ship is permitted to sail on a foreign voyage. Sir Gilbert Blane, in a sensible little tract on the Health of the Navy, says that he has never seen the scurvy resist the citric acid; and that, in the perusal of several hundreds of surgeons' journals, he has met with only two cases which seemed to resist it.

Personel.

Yet, though it appears to have been known as a remedy for the scurvy, far superior to all others, two hundred years ago, it seems to have lain dormant and utterly neglected, till Dr Lind, more than a hundred years afterwards, revived and stated clearly the singular powers of this remedy. In 1600, Commodore Lancaster sailed from England, with three other ships, on the 2d of April, and arrived in Saldanha Bay on the 1st of August. The commodore's crew having each had three table-spoonfuls of lemon juice every morning, arrived there in perfect health; whereas the other ships were so sickly, that they were unmanageable for want of hands. We have all felt the commiseration and horror which the perusal of the narrative of Anson's Voyage produces. His ship, the Centurion, left England with 400 men, of whom 200 were surviving on his arrival at Juan Fernandez, and of these, eight only were capable of duty, from scurvy. Yet even this horrible catastrophe seems to have failed in rousing the nation to have recourse to a remedy so certain and efficacious. Cook was well supplied with vinegar and other acids, and found the good effects of them; but the first general supply of lemon juice to the navy was established only in the year 1795, in consequence of a trial which had been made of it the preceding year in the Suffolk, of seventy-four guns. This ship left England, and arrived at Madras in September, without touching at any land. With every man's grog there were daily mixed two thirds of a liquid ounce of lemon juice, and two ounces of sugar. She lost not a man; and though the disease made its appearance in a few, an increased dose of lemon juice immediately removed it. Thus the Suffolk, after a voyage of 162 days, arrived without losing a man, or having a man sick of the scurvy; whereas the Centurion, in 143 days from the last place of her refreshment, lost half of her crew, whilst the other half were so feeble and emaciated as to be utterly helpless.

Nothing could more strongly point out the efficacy of lemon juice than the following fact. When Lord St Vincent commanded the fleet which blockaded Brest from the 27th of May to the 26th of September 1800, he maintained so close a blockade, that not a single day passed without reconnoitring the entrance of the harbour; yet, although the seamen of his fleet, consisting of at least 16,000 men, had no other than the ordinary ship's provisions, sixteen only, in the course of four months, were sent to the hospital. In 1780 the Channel fleet, as appears from Dr Lind, were so overrun with scurvy and fever as to be unable to keep the sea after a cruise of ten weeks only.

Progressive diminution of sickness.

From the official returns collected by Sir Gilbert Blane, M. Dupin, a French author well versed in naval subjects, has drawn out the following table, which exhibits at one view the progressive diminution of sickness, death, and desertion, in the British navy, calculated on 100,000 men.

Years.	Sick sent to Hospital.	Deaths.	Desertions.
1779	40,815	2654	1424
1782	31,617	2222	993
1794	25,027	1164	662
1804	11,978	1606	214
1813	9,336	698	10

Hence it would appear, that the diminution of sickness and of deaths has been in the proportion of four to one nearly between the years 1779 and 1813. The diminution of desertions from the hospital in the same period is not the less remarkable; and it affords, at the same time, the strongest proof of the progressive amelioration of the condition of seamen on board British ships of war. Indeed, whether on board of ship, or in any of those noble institutions, the naval hospitals, which are established at all the principal ports at home, and in the colonies abroad, the attention which is paid to the sick sailor is above all praise. The seamen are sensible of this, and nothing keeps them back from volunteering their services, and giving a preference to a king's ship over a merchantman, but the temptation of high wages offered by the latter in time of war, and that love of liberty and free scope for roving which are characteristic of seamen.

Manning the fleet.

The speedy manning of the fleet, on the first breaking out of the war, is one of the most important objects that can devolve on the naval administration, as on it alone must depend the safety of our commerce and our colonies. This has been felt at all times; and, accordingly, a variety of schemes have been brought forward for this purpose, but all of them have failed of success, except the compulsory mode of raising men under the authority of press-warrants, issued by the lords commissioners of the admiralty, by virtue of the king's order in council, renewed from year to year. There likewise issues, on the breaking out of a war, a proclamation from the king, recalling all British seamen out of the service of foreign princes or states; and the instructions to the commanders of all ships of war direct them to search foreign vessels, and to take British seamen out of them.

Impressment.

The impressment of seafaring men, however anomalous under a free constitution like that of Great Britain, is defensible on state necessity, until it can be shown that the fleet, on an emergency, is capable of being manned without resorting to that measure. In consequence of some doubts being raised on the legality of the subject in the year 1676, when the affairs of the admiralty were managed immediately under the direction of the king and the great officers of state, a discussion was held on this point, when it was decided by the judges and crown-lawyers, that the king had an indefeasible right to the services of his subjects when the state required them, and that the power of impressing seamen was indispensably inherent in the crown, without which the trade and safety of the nation could not be secured. The first instance of impressing men in Ireland seems to have been in the year 1678, when the lord-lieutenant received directions from the privy council to raise a thousand seamen for the fleet. In 1690, the lords-justices of Ireland were directed to assist the officers of the navy in impressing men in that kingdom. In 1697, a register was taken of all the seafaring men in Ireland, which amounted to 4424 men, of whom it is noted 2654 were Catholics. On several occasions, during Queen Anne's reign, the lords-justices of Ireland received directions to raise men to serve in the fleet.

In Scotland, the mode of raising men by impressment was unknown before the union; but in various instances the council of Scotland was directed to raise volunteers for the fleet, each man to have forty shillings as bounty.

In 1706, an experiment was tried for the speedy manning of the fleet, by virtue of an act of parliament, which required the civil magistrates of all the counties to make diligent search for all seafaring men, and twenty shillings were allowed to the constables for each man taken up; the seamen to have pay from the day of delivery to the naval officers stationed to receive them; and if they deserted after that, they were to be considered as guilty of felony. By the same act, insolvent debtors, fit for the service, and willing to enter it, were released, provided the debt did not exceed L.30; and no seaman in the fleet was to be arrested for any debt not exceeding L.20. The whole proceeding under this act incurred a very heavy expense, and totally failed.

In the same year, the queen referred to the Prince of Denmark, then lord high admiral, an address from the House of Lords, relating to the three following points:—1*st*, The most effectual means for manning the fleet; 2*d*, Personel. the encouragement and increase of the number of seamen; 3*d*, the restoring and preserving the discipline of the navy. His royal highness submitted these points to such of the flag-officers and other commanders as could be assembled, who made a report, of which the substance was to the following effect:—1*st*, To cause a general register to be kept of all seafaring men in England and Ireland, for which they presented the draft of a bill; 2*d*, that all marines qualified to act as seamen should be discharged from the army, the officers to have levy money and the men's clothing returned; 3*d*, that not fewer than 20,000 seamen should be kept in employ in time of peace. But they observe, that as to the restoring and preserving the discipline of the navy, no particular instance being laid before them wherein it was defective, they could give no opinion on that head.

Registry of seamen. This registry of seafaring men has been tried more than once; but as the men themselves had no interest whatever in the measure, it always failed in producing the desired effect. It is now under trial by act of parliament, with great inducements for men to register and enter the naval service.

In fact, there are now so many exemptions from the impress, that its severity is greatly abated. The following descriptions of persons are protected by various acts of parliament:

Masters of merchant ships or vessels.

First mates of such as are fifty tons or upwards.

Boatswains and carpenters of such as are of 100 tons or upwards.

Men belonging to vessels and craft of all kinds in the employment of navy, victualling, ordnance, customs, excise, and post offices.

Watermen belonging to the insurance offices within the cities of London and Westminster.

All men of the age of fifty-five years and upwards.

All youths not having attained the age of eighteen.

All foreigners.

Apprentices not having used the sea before the date of their indentures, and not more than three years from the said date.

Landsmen not having served at sea full two years.

Masters, apprentices, one seaman, and one landsman, of all fishing vessels on the sea coast or on navigable rivers.

Harpooners, line-managers, and boat-steerers of the Greenland fishery and the southern whale fishery; and all seamen and common mariners who have entered for the said fisheries.

And no person whatsoever can be impressed, except by an officer who has been intrusted with a press-warrant.

Discipline. The discipline of the navy, or the government of his majesty's ships, vessels, and forces by sea, is regulated by the act of 22 Geo. II., usually known by the name of the articles of war. By this act, the lords commissioners of the admiralty are empowered to order courts-martial for all offences mentioned therein, and committed by any person in and belonging to the fleet and in full pay; and also to delegate the same power to admirals commanding in chief on foreign stations, which power also may devolve on his successor in case of death or recall, provided that no commander-in-chief of any fleet or squadron, or detachment thereof, consisting of more than five ships, shall preside at any court-martial in foreign parts, the officer next in command being ordered to preside thereat.

Courts-martial. By this act, no court-martial can consist of more than thirteen or of less than five persons, to be composed of such flag-officers, captains, or commanders, then and there present, as are next in seniority to the officer who presides at the court-martial. And when there are but three officers of the rank of captains, the president is to call in as many commanders under that rank as will make up five in the whole.

Personel. This code of laws for the government of the fleet consists of thirty-six articles, of which nine award the punishment of death, and eleven death or such other punishment as the court-martial shall deem the offence to deserve. Those which incur the former penalty are, the holding illegal correspondence with an enemy; cowardice or neglect of duty in time of action; not pursuing the enemy; desertion to the enemy; making mutinous assemblies; striking a superior officer; burning magazines, vessels, &c. not belonging to an enemy; murder; sodomy. The penalty of death for cowardice, or other neglect of duty, in time of action (art. 12), and of not pursuing the enemy (art. 13), was, by the 19th George III. so far mitigated, as to authorize the court-martial "to pronounce sentence of death, or to inflict such other punishment as the nature and degree of the offence shall be found to deserve." Under these articles thus mitigated, Admiral Byng would probably not have been condemned to death. The other eleven articles, which leave the punishment to the discretion of the court, are, not preparing for fight, and encouraging the men in time of action; suppression of any letter or message sent from an enemy; spies delivering letters, &c. from an enemy; relieving an enemy; disobedience of orders in time of action; discouraging the men on various pretences; not taking care of and defending ships under convoy; quarrelling with and disobeying a superior officer in the execution of his office; wilfully neglecting the steering of ships; sleeping on watch, and forsaking his station; robbery. The remaining sixteen articles incur the penalty of dismission from the service, or from the ship, degradation of rank, or such other punishment as the court may judge the nature and degree of the offence to deserve.

Articles of war.

Petty punishment. Much, however, of the internal discipline of a ship of war depends upon the captain, who, being empowered to punish the men for minor offences, according to the usage of the service, courts-martial on seamen are rarely found necessary to be resorted to in well-regulated ships. The principal circumstance which usually militates against the perfect good order of the crew, is the great allowance of grog served out daily to the men, as established by the king's order in council, and which frequently leads to drunkenness, and this again to insubordination. Perhaps half the punishments in the navy are for this offence, which it requires the utmost vigilance and precautions on the part of the officers to prevent.

Effects of discipline. In other respects the discipline of a well-organized ship of war is perfect; and to this discipline M. Dupin, a French writer of great sagacity, mainly ascribes the brilliant successes of the British navy, and to the want of it the ruin of that of France. "We have already cited," says he, "as a model, the management of the *matériel* of the English ships. In the preservation of this *matériel*, in the stowing it away, in the arrangement of whatever may be necessary either for manœuvres or for action, the most perfect regularity is observed. At the same time, what becoming austerity is maintained by the commanding officer; what obedience amongst the subalterns; and, in a space so limited, considering the number of men on board, and the multiplicity of movements they have to make in obeying so many different orders, what imposing silence. It is the calmness of strength, the presiding influence of wisdom. In the midst of the most complicated operations, and even in the heat and transport of battle, one hears only the words of command, pronounced and repeated from rank to rank, with a measured tone and perfect *sang froid*. No unseasonable advices, no murmurs, no tumult. The commanders meditate in silence; the word is given, and the men act without either speaking or thinking."

This is remarkably so in the day of battle. Every officer and man knows precisely his place, and the duty he has to perform, on that day. By the general printed in-

Personel.

structions, the captains of his majesty's ships are required to accustom the men to assemble at their proper quarters, to exercise them at the great guns, to teach them to point, fire, &c. under all circumstances of sea and weather. Indeed, it is well known, that the preservation of the high character of the British navy essentially depends on the proper training of the seamen to the expert management of the guns, so as to be duly prepared in the day of battle; the issue of which so mainly depends on the cool, steady, and regular manner in which the ship's ordnance is loaded, pointed, and fired. Practice in these respects is much more necessary on board ships than on shore, as it can never happen that the ship is entirely steady, and has most frequently a rolling or pitching motion, for which allowances must be made, and which can only be made with effect by long practice.

Naval tactics.

If the management of the great guns of a ship of war is more difficult than the artillery of a fort, so likewise are naval tactics more difficult than those of an army; inasmuch as there is more difficulty and less dependence in placing and directing the movements of an inanimate than an animate machine. The general principles are the same; the object of both being that of bringing the greatest possible force to bear on that point which is likely to produce the greatest possible injury to the enemy. With this view, as well as to keep a fleet together in compact order, so that straggling ships may not be cut off by the enemy, it has been found necessary to preserve a certain order of sailing, whether out of sight of an enemy or in his presence; and such an order as, according to the state of the wind and weather, and the point of bearing of the enemy's fleet, may most conveniently and expeditiously be changed into such a line of battle as the commander-in-chief may deem it most expedient to adopt in the attack to be made on his opponent.

In order to do this, it is obvious that every individual captain must be able to know, under all circumstances, what the ship he commands will be able to do, in order to preserve her station in the fleet; for it is with ships as with horses, no two perhaps performing the same evolution with the same tightness of rein, or the same quantity of sail. This shows the absolute necessity of a commander-in-chief frequently exercising his fleet in naval tactics, and to observe how such and such a ship will behave under a certain quantity of canvass, and to assign her station in the line where she may appear calculated to act with the greatest efficiency.

To facilitate these movements, the admirals commanding squadrons are considered as responsible for the movement of the ships in their respective divisions. They are to see that each captain strictly obeys the general order; and if any one is perceived to neglect his duty, whether belonging to his proper division or not, if in action, he has the power to send immediately another officer to suspend him. And in order that no confusion may arise, if, in time of battle, the admiral commanding in chief, or any of the admirals commanding squadrons, should be killed, his or their flags remain flying till the battle is decided. If the commander-in-chief be killed or severely wounded, a private signal is made to the second in command; or if a junior admiral be killed or wounded, the commander-in-chief is also acquainted by signal.

Code of naval signals.

This silent method of communicating what is going on is the perfection of naval tactics; indeed it is very difficult to conceive how our ancestors contrived to manage a fleet without a code of signals. For great and important occasions, the exhibition of a flag or flags, in some particular part of the ship, might be generally understood to imply that the fleet should anchor, or tack, or form the order of sailing in two lines, or the line of battle, or some other great movement. The hoisting of a cask at the yard-arm might be understood to imply a want of water; or a hatchet, of wood; or an empty bag, of bread; and the table-cloth was a very significant invitation to dinner; but they had no means of interchanging freely their wants or intentions, or of conveying detailed intelligence. Even so late as the American war, there was no established code of signals in the navy. An anecdote is told of Admiral Geary, who, in the year 1780, commanded the Channel fleet, which clearly proves how little was then known or practised in the way of signals. His captain, Kempenfelt, had laboured long to improve the defective system; and having one day seen the enemy's fleet, he endeavoured to communicate the intelligence by the new code; but in the hurry of making sail and giving chase, the signals somehow or other were not understood by the rest of the fleet. Geary at last became impatient, and, running up to Kempenfelt, seized him by the hand, and exclaimed with great emphasis, "Now, my dear Kempy, do, for God's sake, throw your signals overboard, and make the old one, which we all understand,—'to bring the enemy to close action.'"

"If an admiral," says Dr Beatson in his able Memoirs, "cannot command all the necessary movements of his ships by signal in the day of battle, he is not upon a footing with an enemy who possesses that advantage; and, even with better ships and better men, and more experienced commanders, he may be foiled in his expectations of victory, if not defeated, from his want of the means to direct and to perform the necessary evolutions of his fleet." "In no fight," he adds, "was the insufficiency of the present system of naval signals more conspicuous than in this (Keppel's unfortunate action); and it is to be hoped that if ever a new code be adopted for the use of the royal navy, it may be so clear and comprehensive, that such fatal errors as those which have been pointed out will in future be prevented." This, we may now say, has been accomplished.

The idea of *numbering* the flags, and of assigning a certain number of corresponding sentences to certain combinations of these numbers, was reduced to something approaching a regular system in the fleet under the command of Lord Howe[a]; and in the year 1798 a new signal-book was issued from the admiralty, containing about 400 sentences, expressive of certain operations of a fleet, communicated by means of flags to which the numerical characters were applied; and these, as far as they went, answered very well, but did not supersede the necessity of conveying orders by boats on many occasions. The following year Sir Home Popham suggested the idea of making the flags to represent the letters of the alphabet in combination with numbers, which not only added immensely to the means of communication, but also of making use of words by signal. From this time improvements in the modes of communicating by signals and telegraphs were rapidly introduced, particularly in the shape and the colours of the flags, according to a plan of Sir Home Popham, which has rendered signals by flags as nearly perfect as they probably ever will be.

There is, however, an imperfection in the flags themselves; as in calm weather, when they do not fly out, neither their shape nor colour is visible without the use of stretchers, which are not always easily managed, and never without loss of time. Again, if the wind be parallel to the line of vision, the flag shows only its edge, and neither shape nor colour can be discerned. To remedy these inconveniences, Sir Home Popham proposed a portable wooden semaphore, in imitation of the French telegraph, to be mounted on the quarter-deck or poop of a ship.

Sea-telegraph.

It consists of two posts, each having a moveable arm, which may be placed in four positions that can never be mistaken, being at right angles to each other; and the rsonel.

number annexed to each position is that which it conveys to the person receiving the message.

Iprove- nt in nigation. The encouragement afforded by government to every branch of science connected with the navy, and navigation in general, has been carried much farther by England than by any other European nation, and has produced the happiest results for commercial enterprise, by determining with accuracy the precise position of ships, by shortening long voyages, and by the discovery of new lands and unexplored regions. From the commencement of the eighteenth century, when a national reward was first offered to the man of science, or the artist, who should discover a method sufficiently exact to determine the longitude of a ship's place at sea, to the present time, the improvements in the construction and division of all kinds of instruments for measuring angles, in the calculations of lunar and other tables, and, above all, in the manufacture and adjustments of chronometers, have continued in gradual progression, and may now be considered as having arrived at such a degree of perfection, more especially the chronometers, that the discovery of the longitude can scarcely be said to remain a desideratum. We may form an idea what the progress in the improvement of chronometers has been, when a public reward was offered by parliament in the year 1814, to the first who should determine the longitude at sea *within a degree;* and in 1820, three chronometers, after remaining in the arctic regions for eighteen months, returned to England without altering their rates more than a few seconds of time.

Icrease of sence in t navy. The officers of the royal navy are much more generally versed in the sciences of late years than they were heretofore. In fact, it is now necessary for a young man to be well acquainted with a certain portion of mathematical and astronomical knowledge, to enable him to pass an examination, without which he cannot be qualified for the commission of a lieutenant. The examinations also of the several warrant-officers, and their qualifications for their respective stations, are more strictly attended to than heretofore; and the consequence is, that a much better system of discipline without rigour is established throughout the fleet, and more comfort in every respect to every class of officers and men employed.

Personel.

Pay and emoluments. The encouragement given to the navy from its first regular establishment has marked it as a favourite service in the minds of the public. The sea-pay, the half-pay, and other emoluments, have generally been superior to those enjoyed by the army, but subject to great fluctuations in every reign, and to frequent changes in the same reign. Thus King William, in 1693, gave to an admiral L.4 a day, a vice-admiral L.3, and a rear-admiral L.2, which, with the compensation for servants, amounted to more than their present pay; yet their allowances were still further increased in 1700, till a reduction took place in consequence of an address from the Commons. From this time till the year 1806 very little alteration took place, when a small addition was made to the pay of each class.

The following table will exhibit, at one view, the complete war-establishment of commissioned, warrant, petty, and non-commissioned officers, seamen, and marines, on board every class of his majesty's ships, with the rate of pay granted to each, and the classes into which they are divided for the distribution of prize-money or seizures; as established by his majesty's order in council of the 25th November 1816.

FLAG PAY.

Admiral of the fleet	L.6	0	0	Sea-pay *per diem*, besides which every commander-in-chief receives a further sum of L.3 *per diem* whilst his flag may be flying within the limits of his station.
Admiral	5	0	0	
Vice-admiral	4	0	0	
Rear-admiral, or commodore with captain under him; Captain of the fleet	3	0	0	

In flag-ships all the lieutenants, including one extra as flag-lieutenant, are allowed 6d. *per diem* in addition to their pay.

Classes for Distribution of Seizures.		L.	s.	d.	
II.	Physician to the fleet, of less than three years' service as such	L.1	1	0	*per diem.*
	Physician to the fleet, of more than three and less than ten years' service	1	11	6	do.
	Physician to the fleet, of more than ten years' service	2	2	0	do.
	Master of the fleet	15	7	0	*per mensem.*
III.	Secretary to the admiral of the fleet	38	7	0	do.
	Secretary to an admiral commander-in-chief	30	13	8	do.
	Secretary to a vice or rear admiral commander-in-chief	23	0	4	do.
	Secretary to a junior flag-officer or commodore	11	10	0	do.
IV.	Two clerks to secretaries of commanders-in-chief, each	4	12	0	do.
	One clerk to secretaries of junior flag-officers or commodores	3	16	8	do.
	Admiral's coxwain	2	9	0	do.
VII.	Steward; Cook; Domestics *	1	12	0	do.

* The numbers of these ratings to be	
Admiral of the fleet	12
Admiral	10
Vice-admiral	7
Rear-admiral, or commodore with captain under him	5
Captain of the fleet	3

Classes for Distribution of Seizures in Ships and Sloops.	RANKS AND RATINGS.	1st Rate. No.	1st Rate. Pay per Month. L.	s.	d.	2d Rate. No.	2d Rate. Pay per Month. L.	s.	d.	3d Rate. No.	3d Rate. Pay per Month. L.	s.	d.	4th Rate. No.	4th Rate. Pay per Month. L.	s.	d.
I.	Captain	1	61	7	4	1	53	14	0	1	46	0	8	1	38	7	0
II.	1st Lieut. if of 7 years standing	8	11	10	0	7	11	10	0	6	11	10	0				
	All others		9	4	0		9	4	0		9	4	0	5	9	4	0
	Master	1	13	0	8	1	12	5	4	1	11	10	0	1	10	14	8
III.	2d Master	1	5	7	4	1	5	7	4	1	5	7	4	1	5	7	4
	Chaplain	1	12	5	4	1	12	5	4	1	12	5	4	1	12	5	4
	Purser	1	5	7	4	1	4	12	0	1	4	12	0	1	4	4	4
	Surgeon (for pay see note at the end of this table)	1				1				1				1			
	Gunner	1				1				1				1			
	Boatswain	1	7	13	4	1	6	18	0	1	6	2	8	1	5	7	4
	Carpenter (with 7s. per month additional for tools in every rate)	1				1				1				1			
	Master's mate, if passed	6	4	12	0	4	4	4	4	3	4	4	4	2	3	16	8
	Master's mate, not passed		3	16	8		3	9	0		3	1	4		2	13	8
IV.	Midshipman, if passed	24	3	16	8	20	3	9	0	16	3	9	0	10	3	1	4
	Midshipman, not passed		2	13	8		2	6	0		2	6	0		1	18	4
	Assistant surgeon (for pay see note)	3				3				2				2			
	Clerk	1	4	12	0	1	4	4	4	1	4	4	4	1	3	16	8
	Schoolmaster	1				1				1				1			
	Master at arms	1				1				1				1			
	Armourer	1				1				1				1			
	Caulker	1				1				1				1			
	Ropemaker	1	2	10	0	1	2	8	0	1	2	6	0	1	2	4	0
	Sailmaker	1				1				1				1			
	Carpenter's mate (with 7s. per month additional for tools in every rate)	2				2				2				2			
	Gunner's mate	5				4				3				2			
	Boatswain's mate	8				7				6				4			
	Ship's corporal	2				2				2				2			
	Quartermaster	12				12				9				6			
	Captain's coxswain	1	2	4	0	1	2	3	0	1	2	1	0	1	1	19	0
	Coxswain of the launch	1				1				1				1			
	Coxswain of the pinnace	1				1				1							
	Yeoman of the signals	1				1				1				1			
	Captain of the hold	1				1				1				1			
	Captain of the forecastle	3				3				3				2			
V.	Cooper	1				1				1				1			
	Armourer's mate	2	2	4	0	2	2	3	0	2	2	1	0	1	1	19	0
	Caulker's mate	1				1				1				1			
	Sailmaker's mate	1				1				1				1			
	Captain of the foretop	3				3				3				2			
	Captain of the maintop	3	1	19	0	3	1	18	0	3	1	17	0	2	1	16	0
	Captain of the afterguard	3				3				3				2			
	Captain of the mast	3				3				3				2			
	Ship's cook	1	2	11	6	1	2	11	6	1	2	11	6	1	2	11	6

5th Rate.		6th Rate.		Sloops. 100 Men & upwards.		Sloops. Under 100 Men.		Bombs.		Gun Brigs.		Schooners & Cutters.		Classes for Distribution of Seizures in Brigs, Schooners, and Cutters.
No.	Pay per Month. L. s. d.	No.	Pay per Month. L. s. d.	No.	Pay per Month. L. s. d.	No.	Pay per Month. L. s. d.	No.	Pay per Month. L. s. d.	No.	Pay per Month. L. s. d.	No.	Pay per Month. L. s. d.	
1	30 13 8	1	26 17 0	1	23 0 4	1	23 0 4	1	23 0 4					
4	9 4 0	3	9 4 0	2	9 4 0	2	9 4 0	2	9 4 0	1	11 10 0	1	11 10 0	I.
1	9 4 0	1	8 8 0	1	7 13 4	1	7 13 4	1	7 13 4	1	7 13 4	1	7 13 4	II.
1	4 12 0	1	4 12 0											
1	12 5 4	1	12 5 4											
1	4 4 4	1	3 16 8	1	3 16 8	1	3 16 8	1	3 16 8					
1		1		1		1		1						
1		1		1		1		1						
1	4 19 8	1	4 12 0	1	4 12 0	1	4 12 0	1	4 12 0					
1		1		1		1		1						
2	3 9 0	2	3 9 0	1	3 9 0	1	3 9 0	1	3 9 0	1	3 9 0	1	3 9 0	III.
	2 13 8		2 13 8		2 13 8		2 13 8		2 13 8		2 13 8		2 13 8	
3	3 1 4	6	3 1 4	2	3 1 4	2	3 1 4	2	3 1 4	1	3 1 4	1	3 1 4	
	1 18 4		1 18 4		1 18 4		1 18 4		1 18 4		1 18 4		1 18 4	
1		1		1		1		1		1		1		
1	3 9 0	1	3 9 0											
1		1		1	3 9 0	1	3 9 0	1	3 9 0	1	3 9 0	1	3 9 0	
1		1												
1		1		1		1		1						
1		1		1		1		1						
1	2 2 0	1	2 0 0	1	1 19 0	1	1 19 0	1	1 19 0					
1		1		1		1		1						
		1		1		1		1		1	1 19 0	1	1 19 0	
2		2		2		2		1		1		1		
2		2		2		2		1		1		1		
3		1		1		1		1		1		1		
2		3		3		2		2						
5		1		1		1		1		1		1		
1	1 17 0		1 15 0		1 15 0		1 15 0		1 15 0		1 15 0		1 15 0	IV.
1														
1														
1														
2		2		2		1		1						
1		1		1		1		1						
1	1 17 0	1	1 15 0	1	1 15 0	1	1 15 0		1 15 0	1	1 15 0	1	1 15 0	
1		1												
2		2		2		1		1						
2	1 15 0	2	1 14 0	2	1 14 0	1	1 14 0		1 14 0					V.
2		2		1										
2		2		1										
1	2 11 6	1	2 10 6	1	2 10 6	1	2 10 6	1	2 10 6	1	2 10 6	1	2 10 6	

Classes for Distribution of Seizures in Ships and Sloops.	RANKS AND RATINGS.	1st Rate. No.	1st Rate. Pay per Month. L. s. d.	2d Rate. No.	2d Rate. Pay per Month. L. s. d.	3d Rate. No.	3d Rate. Pay per Month. L. s. d.	4th Rate. No.	4th Rate. Pay per Month. L. s. d.
VI.	Volunteer, 1st class	8	1 0 0	7	1 0 0	6	1 0 0	4	1 0 0
VI.	Gunner's crew	25	1 14 0	22	1 14 0	20	1 14 0	13	1 14 0
VI.	Carpenter's crew (with 7s. per month additional for tools in every rate)	18		16		14		12	
VI.	Sailmaker's crew	2		2		2		2	
VI.	Cooper's crew	2		2		2		2	
VI.	Able seaman	L.1. 12s. in all Rates.		The numbers included in these ratings are, in					
VI.	Gunner's yeoman								
VI.	Boatswain's yeoman								
VI.	Carpenter's yeoman								
VI.	Ordinary seaman	L.1. 4s. in all Rates.							
VII.	Cook's mate								
VII.	Barber								
VII.	Purser's steward (in vessels in which a purser is allowed)	L.1. 12s. in all Rates.							
VII.	Captain's steward								
VII.	Captain's cook								
VII.	Ward or gun-room steward								
VII.	Ward or gun-room cook								
VII.	Steward's mate	L.1. 1s. in all Rates.							
VII.	Landman								
VIII.	Boy, 2d class	13	0 12 3	12	0 12 3	10	0 12 3	7	0 12 3
VIII.	Ditto, 3d class	18	0 10 9	17	0 10 9	16	0 10 9	11	0 10 9
VIII.	Widow's men	9	1 12 0	7	1 12 0	6	1 12 0	5	1 12 0
	Total	207		188		166		126	

5th Rate.		6th Rate.		Sloops. 100 Men & upwards.		Sloops. Under 100 Men.		Bombs.		Gun Brigs.		Schooners & Cutters.		Classes for Distribution of Seizures in Brigs Schooners, and Cutters.
[No.]	Pay per Month.	No.	Pay per Month.	No.	Pay per Month.	No.	Pay per Month.	No.	Pay per Month.	No.	Pay per Month.	No.	Pay per Month.	
	L. s. d.		L. s. d.		L. s. d.		L. s. d.		L. s. d.		L. s. d.		L. s. d.	
4	1 0 0	3	1 0 0	3	1 0 0	2	1 0 0	1	1 14 0	2	1 14 0	2	1 14 0	VI.
0	1 14 0	8	1 14 0	6	1 14 0	4	1 14 0							
8		6		4		2								
1		1		1		1								
1		1		1										
														VII.
6	0 12 3	5	0 12 3	4	0 12 3	2	0 12 3	1	0 12 3	1	0 12 3	1	0 12 3	VIII.
10	0 10 9	9	0 10 9	6	0 10 9	2	0 10 9	5	0 10 9	2	0 10 9	2	0 10 9	
3	1 12 0	2	1 12 0	1	1 12 0	1	1 12 0	1	1 12 0					
06		87		65		47		34		18		18		

			Making the total war compliment of
1st Rates	1st Class	533	900
	2d Class	483	850
	3d Class	433	800
2d Rates	1st Class	362	700
	2d Class	312	650
3d Rates	1st Class	359	650
	2d Class	309	600
4th Rates	1st Class	264	450
	2d Class	164	350
5th Rates	1st Class	144	300
	2d Class	124	280
6th Rates	1st Class	63	175
	2d Class	33	145
	3d Class	13	125
Sloops, Brigs, &c.	1st Class	50	135
	2d Class	40	125
	3d Class	36	95
	4th Class	16	75
	5th Class	30	60
		20	50

Personel.

Classes for Distribution of Seizures in Ships and Sloops.	RANKS AND RATINGS.	Number in each Rate.											Pay of Marines in all Rates.	Pay of Marine Artillery.
		1st Rate.	2d Rate.	3d Rate.	4th Rate.	5th Rate.	6th Rate.	Sloops 100 Men and upwards.	Ditto under 100 Men.	Bombs.	Gun-Brigs.	Schooners and Cutters.		
	MARINES.													
II.	Captain Ditto if brevet-major	1	1	1	1	...	...	...	...	...	...	...	14 14 10 17 10 10	15 8 0 18 4 0
III.	1st Lieutenant. Ditto after 7 years Ditto under 7 years 2d Lieutenant	3	3	2	1	2	1	...	...	1	...	...	10 10 7 9 2 4 7 7 5	10 19 4 9 11 4 7 16 4
IV.	Serjeant Ditto if colour serjeant	4	3	3	2	2	1	1	1	1	1	1	1 18 1 2 12 1	2 16 9 3 10 9
V.	Corporal. Ditto after 14 years Ditto from 7 to 14 years Ditto under 7 years	4	3	3	2	1	1	1	1	1	1	1	1 10 1 1 7 9 1 5 5	2 14 0 2 11 8 2 9 4
VI.	Drummer	2	2	2	1	1	1	1	...	...	...	...	1 1 4	1 4 5
	Bombardier. Ditto after 14 years Ditto from 7 to 14 years Ditto under 7 years	...	...	...	...	...	...	...	...	1	...	...	...	2 9 6 2 7 2 2 4 10
	Private or gunner. Ditto after 14 years Ditto from 7 to 14 years Ditto under 7 years	146	138	114	53	44	21	17	10	10	10	10	1 1 6 0 19 2 0 17 5	1 9 1 1 6 9 1 4 5
	Total marines	160	150	125	60	50	25	20	12	14	12	12		

Note.—To this table it may be added, that captains who, on the death or absence of a commander-in-chief, are authorized to hoist a distinguishing pendant, are entitled to receive the pay of L.1 per day in addition to their pay as captains, while the pendant is flying within the limits of the station.

Surgeons of Ships in Active Service.

Under 6 years service	10s.	a day.
After 6 ditto	11s.	do.
— 10 ditto	14s.	do.
— 20 ditto	18s.	do.

Surgeons in Receiving-Ships, Prison-Ships, &c.

In harbour-duty	10s.	a day.
Surgeons of hospital-ships	15s.	do.
Assistant-surgeons	6s. 6d.	do.

Establishment of half-pay.

Though the navy, as we have seen, was put upon a regular establishment under the reign of Henry VIII., neither officers nor seamen received any pay or emolument in time of peace, until the reign of Charles II., when, in 1668, certain allowances were made to flag-officers and their captains out of the L.200,000 a year voted for the whole naval service; and in 1674, certain other allowances were granted, by order in council, to captains who had commanded ships of the first and second rate, and to the second captains to flag-officers, on the ground, as assigned in the preamble, that they had undergone the brunt of the war, without sharing in the incident advantages of it, as prizes, convoys, and such like, which the commanders of the smaller classes of ships had enjoyed. But the first regular establishment of half-pay for all flag-officers, captains, first-lieutenants, and masters, was by King William, in the year 1693, provided they had served a year in their respective qualities, or had been in a general engagement with the enemy. A regular established half-pay was further sanctioned by an order in council of Queen Anne in 1700; the conditions of which were, that no officer should enjoy the benefit thereof who had absented himself without permission of the lord high admiral or lords commissioners of the admiralty, or who had been dismissed for any misdemeanour, or by court-martial, or who had not behaved himself to the satisfaction of the lord high admiral, or who should have leisure to go out of his majesty's dominions, if employed in the merchant service or otherwise, or who enjoyed the benefit of any public employment. Since the above period the rate of half-pay to the several officers of the navy has undergone various modifications. At present it stands thus:

Personel.

RATES OF HALF-PAY.

Flag-Officers.

	Per Diem.
Admirals of the fleet	L.3 3 0
Admirals	2 2 0
Vice-admirals	1 12 6
Rear ditto	1 5 0

Captains.

To each of the first 100 as they stand on the general list of officers in seniority	0 14 6
To each of the next 150	0 12 6
To the rest	0 10 6

Commanders.

To each of the first 150 on the list	1 10 0
To the remainder	0 8 6

Lieutenants.

To each of the first 300 on the list	0 7 0
To each of the next 700	0 6 0
To the remainder	0 5 0

Royal Marines.

Colonels	0 14 6
Lieutenant-colonels	0 11 0
Majors	0 9 6
Captains	0 7 0
First lieutenants of seven years standing	0 4 6
The rest	0 4 0
Second lieutenants	0 3 0

Masters.

To the first 100 on the list (being qualified for first or second rates)	0 7 0
To the next 200 (being qualified for third or fourth rates	0 6 0
The remainder having served five years in the navy, two of which as acting or second master, or as master's mate or midshipman	0 5 0

Medical Officers.

Physicians.

After ten years service	1 1 0
After three years	0 15 0
Under that time	0 10 6

Surgeons.

Six years service	0 6 0
Under that time	0 5 0

Assistant Surgeons.

Three years service	0 3 0
Two years	0 2 0
Dispensers	0 5 0

Chaplains.

After eight years service at sea, or ten in harbour	0 5 0
For less service, not under three years	a proportion of the above.
For each year's longer service than ten years, 6d. per diem additional till it reach	0 10 0

Pursers.

To the first 100 on the list	0 5 0
Do. next 200 do.	0 4 0
The remainder	0 3 0

Payable quarterly.

The boatswains, gunners, and carpenters of the navy, have pensions or superannuations, in lieu of half-pay, according to the following scale, formed on a consideration of the total length of service as warrant-officers, with the length of service in commission.

Total Service. Years.	Commissioned Service. Years.	Pension. L.
30	20	85
30	15	75
30	10	65
30	5	55
20	20	75
20	15	65
20	10	55
20	5	45
15	15	60
15	10	50
15	5	40
10	10	45
10	5	35

Naval prize-money.

In point of half-pay and other pecuniary emoluments, the navy has much the advantage over the army, more particularly in the chance of prize-money, which but seldom falls to the share of the army, except on some conjoint expedition. On the commencement of a war a proclamation is issued by the king, directing that the net produce of all prizes taken by any of his ships of war shall be for the entire benefit and encouragement of the flag-officers, captains, commanders, and other commissioned officers, and of the seamen, marines, and soldiers on board at the time of the capture; and directing also in what manner the distribution shall be made. Many very handsome, and, in some instances, very splendid fortunes, have been made by captures of the enemy's ships.

Honours and rewards.

Another great encouragement for young men to enter the naval service arises from the honours bestowed by the sovereign for any brilliant exploit. Thus, in consequence of the skill and bravery which were exhibited in the great and glorious action of the 1st of June 1794, his majesty was graciously pleased to confer on Earl Howe the order of the garter; Admirals Graves and Sir Alexander Hood were made barons of the kingdom of Ireland; and Rear-admirals Bowyer, Gardner, and Pasley, together with Sir Roger Curtis, captain of the Queen Charlotte, were created baronets. Gold medals and chains were also distributed to such admirals, and gold medals to such captains, as were particularized in Lord Howe's despatches. The first lieutenants of each ship were promoted to the rank of commanders; and pensions of L.1000 per annum were granted to Rear-admirals Bowyer and Pasley, in consideration of the loss of limbs.

For the action of 14th of February 1797, Lord St Vincent was advanced to the dignity of an earl, and a pension was granted to him of L.3000 a year; Vice-admirals Thompson and Parker were created baronets; Commodore Nelson received the order of the bath, and Captain Calder of the Victory the honour of knighthood; and gold medals were distributed to the admirals and captains.

For the action of the 11th of October 1797, Admiral Duncan was created a viscount, with a pension of L.2000 a year; Vice-admiral Onslow was made a baronet; and Captain Fairfax had the honour of knighthood. Gold medals were also distributed to the admirals and captains.

For the action of the 1st of August 1798, his majesty was pleased to testify his sense of the importance of this brilliant achievement, by raising Sir Horatio Nelson to the dignity of the peerage, by the title of Baron Nelson of the Nile; and by directing medals to be distributed to the captains. The first lieutenant of the Majestic was made a captain, and the first lieutenants of the other ships were

Personel.

promoted to the rank of commanders. And for the attack of the Danish fleet at Copenhagen, Lord Nelson was raised to the dignity of a viscount, and the order of the bath was conferred on Admiral Graves.

For the ever memorable action of Trafalgar, in which Lord Nelson fell in the arms of victory, his majesty was pleased to confer upon his brother the rank of earl, with a pension of L.5000 a year; and the sum of L.120,000 was voted by parliament for the purchase of an estate to be annexed to the title. Admiral Collingwood was raised to the dignity of baron; Lord Northesk was honoured with the order of the bath, and Captain Hardy was created a baronet. The captains received medals; five lieutenants were made captains, and twenty-four, commanders; twenty-two midshipmen were made lieutenants; and the senior captain of marines was made brevet-major.

By this last act of Lord Nelson's life was annihilated the only remaining hope of the combined navies of France and Spain, and a blow given to the naval power of the enemies of Great Britain, which they never recovered during the remainder of the war.

In the secondary victories of Sir John Warren, Sir John Duckworth, Sir Robert Calder, Sir Richard Strachan, Lord Gambier, and Lord Exmouth, and even for brilliant actions of single ships, appropriate distinctions have never been withheld. Exclusive of peerages and baronetcies, the honours bestowed for gallant conduct in the naval service consist of twenty-five grand crosses of the bath, seventy knights commanders, and 130 companions of the bath.

Pensions for wounds.

The provision which is made for officers, in the event of losing a limb, or being so severely wounded in the service that the prejudice to the habit of body is equal to the loss of a limb, is another encouragement for entering the naval service.

For an admiral, from L.300 to L.700 per annum.
A captain, wounds, L.250; loss of a limb..............L.300
Commander...do... L.150; do..........................L.200
Lieutenant.....do... L.91. 5s.; do....................L.91. 5s.
Marine officers the same as in the army.

Widows' pensions.

A provision is likewise made for the widows of the commission and warrant officers of his majesty's navy, by order of the king in council, and voted annually on the navy estimates. The pensions are allowed according to the annexed scale, being similar in most cases to the widows of officers in the army of corresponding ranks. The latter are also provided for by an annual vote of parliament.

Scale of Pensions.

The widow of a flag-officer of his majesty's fleet	L.120	0	0
——— of a captain, superannuated with the rank of rear-admiral	100	0	0
——— of a captain of three years standing	90	0	0
——— of a captain under three years standing	80	0	0
——— of a commander	70	0	0
——— of a lieutenant, superannuated with the rank of commander	60	0	0
——— of a lieutenant	50	0	0
——— of a master	40	0	0
——— of a surgeon	40	0	0
——— of a purser	30	0	0
——— of a boatswain	25	0	0
——— of a gunner	25	0	0
——— of a carpenter	25	0	0
——— of a second master of a yacht, or master of a naval vessel warranted by the navy board	25	0	0

And the widows of officers of the royal marines are entitled to the following pensions:

	Per Annum.		
The widow of a general officer	L.120	0	0
Ditto colonel	90	0	0
Ditto lieutenant-colonel	80	0	0
Ditto major	70	0	0
Ditto captain	50	0	0
Ditto first lieutentant and surgeon	40	0	0
Ditto second lieutenant and assistant surgeon	20	0	0

Compassionate fund.

In addition to these pensions, there has been established a *Compassionate Fund*, for the relief of such widows and orphan children as may appear to be proper objects of compassion. The sums annually required are voted by parliament, and at present are limited to L.14,000 a year.

Pensions to petty officers and seamen are granted by the board of admiralty for wounds, infirmities, and length of service; and the sum required for this purpose is voted annually on the navy estimates.

Greenwich Hospital.

The establishment of Greenwich Hospital embraced much more extensive objects. The first idea of this noble institution, the glory and ornament of the kingdom, has been ascribed, with every appearance of justice, to Mary, the consort of William III. Being desirous that our gallant seamen, worn down by age or infirmities, as well as suffering from wounds, should not be left destitute, she made a grant, jointly with King William, of the palace of Greenwich, and of certain lands adjoining, to be appropriated to this purpose, in order, as stated in the king's commission, to "the making some competent provision, that seamen, who, by age, wounds, or other accidents, shall become disabled for further service at sea, and shall not be in a condition to maintain themselves comfortably, may not fall under hardships and miseries, but may be supported at the public charge; and that the children of such disabled seamen, and also the widows and children of such seamen as shall happen to be slain in sea service, may, in some reasonable manner, be provided for and educated." In 1695, the committee appointed to examine and report on the premises recommended an additional wing to King Charles's building, which being approved by the king, Sir Christopher Wren undertook to superintend the new erections without any pay or reward. Since that time various additions and improvements have been made to this magnificent pile of building, which was completed very nearly as it now appears, in the year 1778.

The king granted L.2000 a year towards the carrying on, perfecting, and endowing of this hospital. The great officers of state and wealthy individuals also subscribed liberally to the undertaking. It was at the same time enacted by parliament, that a deduction of sixpence per man per month should be made out of the wages of all mariners for the use of the hospital; and power was given to the lord high admiral to appoint commissioners for receiving the said duty, whose office is situated on Tower Hill. These deductions no longer exist, and the establishment has been broken up. In 1699 his majesty contributed the sum of L.19,500, being fines laid by the House of Lords on certain merchants convicted of smuggling. In 1705 Queen Anne assigned to the use of the hospital the effects of Kid the pirate, amounting to upwards of L.6000. In 1707, Robert Osbaldiston, Esq. devised by will half of his estate, which was valued at L.20,000. In the same year Anthony Bowyer gave the reversion of a considerable estate for the use of the hospital. By several statutes, the forfeited and unclaimed shares of prize-money were given to the hospital, and various grants, from time to time, continued to be made by parliament. But the most substantial grant was that made by the Commons, of the rents and profits of the forfeited estates of the Earl of Derwentwater, amounting at that time to about L.6000 a year, and at present to the gross rental of L.60,000, of which, after payment of all expenses for improvements, repairs, collections, and incumbrances, the annual receipt may be estimated at from L.30,000 to L.40,000.

At present the permanent revenues of the hospital consist of the following heads:

1. The duties arising from the North and South Foreland light-houses.
2. The rents and profits of the Derwentwater estates, including the lead mines.
3. Rents of the market of Greenwich, and of certain houses there and in London.
4. Interest of money invested in the public funds.
5. Forfeited and unclaimed shares of prize-money.
6. Fines for various offences.

It is evident that the funds of the establishment must vary considerably in times of war and peace; being lowest in the latter period, when the demands are heaviest upon it, especially for a certain number of years after the close of a war.

The rental of the estates belonging to the hospital in the counties of Northumberland, Cumberland, and Durham, rose from L.23,000 in 1805, to L.43,000 in 1816. The present gross rental of these estates and the lead mines, as above stated, amounts to about L.60,000, the North and South Foreland lights to L.7000, and the interest of funded property to L.50,000; making, with other contingencies, an annual revenue of about L.150,000, the whole of which is expended on the household establishment, the clothing, maintenance, and allowances to pensioners and other attendants, with repairs, taxes, and contingencies.

The establishment of this noble institution consists of a governor, who is a flag-officer in the navy, lieutenant-governor, four captains, and eight lieutenants, all resident within the hospital; a treasurer, auditor, paymaster of pensions, secretary, clerk of the check, two chaplains, two physicians, three surgeons, two dispensers, steward, clerk of the works, and several clerks. The number of in-pensioners is about 3000, and the number of nurses 180, all of whom must be the widows of seamen of the navy, and under the age of forty-five years at the time of admission.

Under the naval administration of Earl Grey, the following officers were added to the out-pensions of Greenwich Hospital, to be selected by the admiralty, according to their respective claims on the service:

	Per Year.
10 Captains at	L.80
15 Commanders at	60
50 Lieutenants at	50

in addition to their half-pay.

The out-pensions to seamen were first established in the year 1763, by act of 3d Geo. III. ch. 16, in consequence of which 1400 out-pensioners were appointed at L.7 per annum each, after undergoing an examination at the admiralty as to their claims.

At the close of the long revolutionary war, the applications became so numerous, and the claims of the seamen who had been wounded or worn out in the service so strongly grounded in humanity and justice, that it became necessary to adopt a scale of pensions, and to establish certain rules and regulations, by which seamen of his majesty's fleet and royal marines should be remunerated for wounds or hurts, debility, and length of service. The following are the regulations.

For Wounds, Hurts, or Debility.

Every seaman, landman, boy, or royal marine, wounded or hurt in his majesty's service, is entitled to a pension proportioned to his wounds or hurts, of not less than sixpence a day, and not more than one shilling and sixpence a day. For sickness or debility, after seven years' service, and under special circumstances before that period, of not less than fivepence a day, nor more than tenpence, according as he may appear capable of assisting himself. Beyond fourteen, and less than twenty-one years' service, not less than eightpence, nor more than one shilling and threepence. And after twenty-one years' service, one shilling and sixpence a day. But the rates are altered from time to time.

All the above-mentioned pensions may be forfeited by misconduct, by desertion, and by sentence of a court-martial; also by neglecting or omitting to attend at such port or place, and at such time, as shall, in time of war, or in prospect of a war, be appointed for the assembling of the pensioners, by the lords commissioners of the admiralty.

To the noble institution of Greenwich Hospital is appended an asylum for the maintenance and education of the children of officers and seamen of his majesty's naval service.

Naval Asylum.

The Naval Asylum was originally instituted by the Patriotic Fund and private subscriptions, and afterwards established at Greenwich, by warrant under the king's sign-manual, dated in January 1818, appointing the lords commissioners of the admiralty to be commissioners and governors, who, with twenty-four directors, were to superintend and manage the same. The object was, the maintenance and education of a certain number of orphans and other children of the non-commissioned officers, seamen, and marines of the royal navy. As it was manifest, however, that this establishment, so contiguous to the hospital of Greenwich, could be managed without inconvenience by the commissioners and directors of that hospital, under a more effective and economical system, his majesty was pleased, by his warrant of January 1821, to annul the former warrant, and to vest the superintendence and internal management of the said asylum in the commissioners and governors of Greenwich Hospital.

The two schools of Greenwich Hospital and the Naval Asylum, and the funds thereof, are now therefore incorporated. The internal management is confided to the board of directors, and one of the captains of the hospital is intrusted with the general superintendence. A chaplain, and proper schoolmasters, schoolmistresses, matron, and inferior assistants, male and female, with moderate salaries, reside in the building. The number of children maintained and educated in the institution are,

In the boys' upper school	200
... lower school	600
Girls	200
In the whole	1000

To the upper school no boys are admitted but the sons of seamen and marines, slain, drowned, or dead; those of pensioners in the hospital; of seamen disabled, past their labour, or otherwise objects of charity; and of officers in the navy and marines, on the production of a required certificate of poverty. The age of admission is from eleven to twelve, and the continuance in the school three years, at the expiration of which they are bound apprentices to the merchant service. Presentations by the directors in rotation.

The boys and girls of the lower school are the children of seamen and marines of the naval service, admitted by the board of directors, giving a preference to orphans. The age of admission is from nine to twelve years inclusive; but none is retained beyond the age of fourteen. The boys are sent into the navy, or merchant service, or put apprentices to some trade. The girls, at the age of fourteen, are apprenticed to trades, or sent to service.

Thus all the classes of officers, seamen, and marines, who have faithfully served in the navy, are provided for by the state; and the children of such as may be in indigent circumstances receive an education at the public expense, suited to their condition in life.

The total expense of the navy, including every branch of the service, civil and military, for one whole year, about the middle of the last war, may be estimated at about L.18,000,000. In the year 1822, according to the estimates which were laid before parliament, it amounted to about L.5,000,000; and in the year 1837 it has been fixed at the sum of L.4,663,000. (M.)

NAXIA, the anxient Naxos, is one of the largest and most fertile of the islands in the Archipelago, known as the Cyclades. Its greatest length from north to south is seventeen miles, and its greatest breadth about twelve miles. The north point is in latitude 37. 12. Although the rocks are of a most repulsive appearance, yet the island is diversified by hills, valleys, and plains, and is well wooded and watered. Besides the city of its name, it contains thirty-five villages, and a population of about 17,000 persons. It produces corn equal to six months' consumption, and a surplus of oil, fruits, and cheese. Large quantities of oranges and lemons are exported. There is no port on the island for ships to enter.

NAXOS, or NAXIA, a considerable town, and capital of the Isle of Naxos, opposite the Isle of Paros, with a castle and two archbishops' sees, the one Greek and the other Latin. The greater part of the inhabitants are Greeks. Long. 25. 51. E. Lat. 37. 8. N.

NAYO, a small island in the Eastern Seas, near to the north coast of Celebes. Long. 124. 24. E. Lat. 1. 24. N.

NAYRES are the nobility of the Malabar coast. We may with truth affirm that they are the oldest nobility in the world; for the most ancient writers mention them, and quote the law which permits the Nayre ladies to have several husbands, every one being allowed four.

NAZARETH, a town or village of Palestine, celebrated in holy writ as the residence of our Saviour. It is situated in a deep valley, on the side of a high hill, nearer to its summit than its base, and having a rocky eminence along it. It contains about 250 buildings of stone, a material always at hand. They are flat-roofed, generally of only one story, but sufficiently spacious for the accommodation of the numerous poor families by whom they are inhabited. The streets are steep and narrow, and, from the looseness of the soil, exceedingly dirty. Of the public buildings the mosque is the most conspicuous, and is a neat edifice. It is enclosed with a good wall of masonry, so that Mr Buckingham, who visited it, could only see one of its sides, on which there were five arches. It has a plain whitened minaret, surrounded by a gallery, and surmounted by a crescent. The Greeks have a church on the south-eastern edge of the town, at the foot of a hill; and the Maronites have also a church in front of a Franciscan convent. This convent, Mr Buckingham mentions, is one of the largest and most commodious he had seen anywhere, being superior to those of Smyrna, Alexandria, or Cairo. It is still adorned with some precious remains of antiquity. Two antique shafts of red granite columns are used as portals to the door-way. Within is a court, and near the gate at its further extremity is the fragment of a shaft of another granite column, lying on the ground. White pillars form the portals of entrance to the original building, destroyed by the Turks; and of these the remains are still to be seen. On the wall, both within and without, there are worked into the masonry several pieces of the old ruins, containing delicate sculptures of frize, cornices, capitals, &c. The gate leads to a large paved square, in which there are two wells, surmounted by the cross; and on the right hand is the hall for the reception of strangers and visitors. The interior is furnished with every convenience, in staircases, galleries, and apartments. Mr Buckingham mentions, that he supped in a hall below, of considerable size. The table service consisted altogether of pewter, but every thing was extremely clean, and the provisions were excellent, particularly fine wheaten bread, and wine from Mount Lebanon, not inferior to the wines of France. The church belonging to the monastery is erected over a grotto, which is believed to have belonged to the Virgin Mary. In this place are shown her kitchen and fire-place; and by way of miracle a pillar is exhibited, the capital of which, separated from the shaft, is represented as self-supported in the air. Dr Clarke, however, soon observed that it was fastened into the wall above. Mr Buckingham was shown a second grotto, or a continuation of the first, with two red granite pillars, of about two feet in diameter at its entrance; and he was told that the one marked the spot where the Virgin rested, the other where the angel stood when he appeared to Mary. The church erected over this sacred spot is large, and well furnished with paintings, mostly gaudy, though there were a few not altogether devoid of merit. The synagogue in which Jesus read and expounded the prophet Esaias is shown here within the town; the precipice from which his enemies would have thrown him down is also pointed out; and, according to Mr Buckingham, it is not improbable that this precipice, which overlooks the town, was the scene of this outrage. But the most venerated relic is a stone called the table of Christ, from which he is asserted to have eaten before and after his resurrection. Nazareth forms part of the pachalik of Acre, and was reduced to indigence and misery by the oppression of Djezzar Pasha. Many of the wretched people emigrated in consequence; and several of the neighbouring Arabs said to Dr Clarke, that the beggars in England were better and happier than they. The stationary inhabitants are about 2000, of whom 500 are Catholic Christians, about 300 Maronites, and 200 Mahommedans, the rest being schismatic Greeks. Nazareth is fifty miles north from Jerusalem.

NAZARITE, or NAZAREAN, or *Nazarene*, a term which signifies one who is of Nazareth, or any native of the city of Nazareth. It was given to Jesus Christ and his disciples, and is commonly employed in a sense of derision and contempt by those authors who have written against Christianity. It has also been applied to a sect of heretics called Nazarenes; and sometimes it means a Nazarite, or one who has laid himself under the obligation of a vow to observe the rules of Nazariteship, whether it be for his whole life, as Samson and John the Baptist, or only for a time, as in the case of those mentioned in Numbers (vi. 18, 19, 20) and Amos (ii. 11, 12). Lastly, the name of Nazarite, in some passages of Scripture, denotes a man of particular distinction and great dignity in the court of some prince. Of these several sorts of Nazarites we shall now give some account.

The name of Nazarene belongs to Jesus Christ, not only because of his having lived the greater part of his life at Nazareth, and because this city has always been considered as his country, but also because the prophets had foretold that he should be called a Nazarene (Matth. ii. 23). "And he came and dwelt in a city called Nazareth, that it might be fulfilled which was spoken by the prophets, He shall be called a Nazarene." We find no particular passage in the prophets where it is said that the Messiah should be called a Nazarene; and St Matthew only quotes the prophets in general. Perhaps he meant to insinuate, that the consecration of the Nazarites, and the great purity of which they made profession, were a type and a sort of prophecy of those of our Saviour, or else that the name *Nazir* or *Nazarite*, given to the patriarch Joseph (Gen. xlix. 26; Deut. xxxiii. 16), was a prophecy which was to be fulfilled in the person of Jesus Christ, of whom Joseph was a figure. Lastly, St Jerome was of opinion, that St Matthew here alludes to a passage in Isaiah, where it is said, "And there shall come forth a rod out of the stem of Jesse, and a branch (*Nezer*) shall grow out of his roots." According to the general consent of all the fathers and interpreters, this branch, or *Nezer*, and this root, are intended to denote Jesus Christ.

When the word Nazarene is applied to the heretics known by this name, it denotes Christians converted from Judaism, whose chief error consisted in defending the necessity or expediency of the works of the law, and who obstinately adhered to the practice of the Jewish ceremonies. The name of Nazarenes at first had nothing odious attached to it, and it was often applied to the first Christians. The fathers frequently mention the Gospel of the Nazarenes, as differing in nothing from that of St Matthew, which was either in Hebrew or Syriac, being for the use of the first converts, but afterwards corrupted by the Ebionites. These Nazarenes preserved the first gospel in its primitive purity. Some of them were still in being in the time of St Jerome, who does not reproach them with any error; they were very zealous observers of the law of Moses, and held the traditions of the Pharisees in supreme contempt.

Nazarite, when used to signify a person under the ancient law who had made a vow of observing a more than ordinary degree of purity, denotes a man or woman who engages himself or herself by a vow to abstain from wine and all intoxicating liquors, to let the hair grow without cutting or shaving, and not to enter into any house which was polluted by having a dead corpse in it, or to be present at any funeral. But if by chance any one should have died in the presence of such a person, he or she began again the whole ceremony of consecration and Nazariteship. This ceremony generally lasted eight days, sometimes a month, and sometimes their whole lives. When the time of their Nazariteship had been accomplished, the priest brought the person to the door of the temple, who there offered to the Lord a he-lamb for a burnt-offering, a she-lamb for an expiatory sacrifice, and a ram for a peace-offering. They likewise offered loaves and cakes, with wine necessary for the libations. After all this had been sacrificed and offered to the Lord, the priest or some one else shaved the head of the Nazarite at the door of the tabernacle, and burned his hair, throwing it upon the fire of the altar. Then the priest put into the hand of the Nazarite the shoulder of the ram roasted, with a loaf and a cake, which the Nazarite returned into the hands of the priest, who offered them to the Lord, lifting them up in the presence of the Nazarite; and from this time he might again drink wine, his Nazariteship being now accomplished. As to those who were perpetual Nazarites, like Samson and John the Baptist, it appears that they were consecrated to their Nazariteship by their parents, and continued all their lives in this state without drinking wine or cutting their hair.

Those who made a vow of Nazariteship out of Palestine, and could not come to the temple when their vow was expired, contented themselves with observing the abstinence required by the law, and afterwards cutting their hair in the place where they happened to reside. As to the offerings and sacrifices prescribed by Moses, which were to be offered by themselves, or by others for them at the temple, they deferred this till they found a convenient opportunity. Hence it was that St Paul being at Corinth, and having made the vow of a Nazarite, he had his hair cut off at Cenchrea, and postponed fulfilling the remainder of his vow till he should arrive at Jerusalem (Acts, xviii. 18). When a person found that he was not in a condition to make a vow of Nazariteship, or had not leisure to perform the ceremonies which it rendered necessary, he contented himself by contributing to the expense of the sacrifice and offerings of those who had made and fulfilled the vow; and by this means he became a partaker in the merit of such Nazariteship. When St Paul went to Jerusalem, in the year of Christ 58, the apostle St James the Less, with the other brethren, said to him (Acts, xxi. 23, 24), that to quiet the minds of the converted Jews, who had been informed that he everywhere preached up the entire abolition of the law of Moses, he ought to join himself to four of the faithful who had made a vow of Nazariteship, and contribute to the charge of the ceremony at the shaving of their heads; by which the new converts might perceive that he continued to keep the law, and that what they had heard of him was not true.

The Hebrew word *Nazir*, which is employed to signify a person exalted to great dignity, as it is said of the patriarch Joseph (Gen. xlix. 26; and Deut. xxxiii. 16), "that he was separated from his brethren," as it is in our translation, or as the Vulgate and others understand the Hebrew, "that he was a Nazarite amongst his brethren," has been variously understood. Some think that the Hebrew word *Nazir*, in these places, signifies one who is crowned, chosen, separated, or distinguished; indeed the word *Nazir* signifies a crown. The Septuagint translate this word a *chief*, or him who is honoured. Calmet thinks that it was a term of dignity in the courts of eastern princes; and mentions, that at this day in the court of Persia the word *Nazir* signifies the superintendent-general of the king's household, the chief officer of the crown, the high steward of his family, treasures, and revenues; in which sense Joseph was the Nazir of the court of Pharaoh. Le Clerc translates the term *Nazir* a prince, and calls Joseph "the prince of his brethren;" and Pool declares in favour of this last translation.

NAZIM, a river of Asiatic Russia, in the government of Tobolsk and district of Berezof, which falls into the Obi, after a course of 160 miles.

NAZOOK, a large lake of Armenia, situated amongst the mountains, in a bare and desolate country, being thirteen miles in length and five in breadth.

NEALING, or rather ANNEALING, a term used to signify the preparing of several matters, by heating or baking them in the oven, or otherwise. See ANNEALING.

NEAMUTSERAI, a fortified village of Afghanistan, in the district of Puckoli, on the north-eastern border of Lahore. It has a caravanserai, which is placed in a break of the great range of mountains, which extends from the Punjab to the Indus. Long. 71. 50. E. Lat. 33. 30. N.

NEAP or NEEP TIDES are those tides which happen when the moon is in the middle of the second and fourth quarters. The neap tides are low tides in respect of their opposites the spring tides. As the highest of the spring tides is three days after the full or change, so the lowest of the neap tides is four days before the full or change; on which occasion the seamen say that it is deep neap.

NEAPED. When a ship wants water, so that she cannot get out of the harbour, off the ground, or out of the dock, the seamen say she is *neaped*, or *beneaped*.

NEARCHUS, the admiral of Alexander the Great, was the son of Androtinus, a native of Crete, and flourished 330 before Christ. He was the personal friend of Alexander before the death of his father, and was obliged to fly from Macedonia when Philip began to be suspicious of the intentions of his son. Nearchus attended Alexander

Nearchus. in his eastern expedition, and was left to watch over Lycia and the adjoining countries. (Arrian, iii. 6, 8; Irid. 18, 4, 10.) After the conquest of Darius, he was called from his province by Alexander, and appointed to command the fleet which was hastily constructed on the river Hydaspes,[1] from the timber which grew upon its banks. Onesicritus was appointed second in command. Both admirals afterwards left a detailed account of their voyage from the mouth of the Indus, where they parted with Alexander, proceeding along the coast towards the Persian Gulf, and as far as the river Euphrates. The journal of Nearchus has luckily been preserved for us by Arrian in his Indian history (cap. 20), and it corresponds in general so closely with the descriptions of modern navigators, that there can be no doubt of its authenticity. Strabo (ii. 70) indeed expresses doubts respecting the correctness of his statements; and perhaps there may have been some exaggeration of the dangers he encountered, and the wonders he saw, but he has certainly given a very accurate account of the coast along which he sailed.

This was the first time that a Greek fleet had entered the Indian Ocean; and when Alexander made known his intentions, the sailors murmured at the unknown dangers to which they were going to be exposed. The appointment, however, of his beloved friend Nearchus to command the exploring expedition quieted their apprehensions, as they were satisfied that the dangers could not be so great as they imagined, when Alexander was willing to allow Nearchus to be exposed to them. Alexander left the fleet at a spot called Xylenopolis, in the month of August 326 before Christ, and proceeded with his army across the sandy deserts of Mekran to Persia. About the month of October, when the south-west monsoon had ceased to blow, Nearchus sailed down the western branch of the Indus, now called Buggaur, into the Indian Ocean, which he reached after a passage of 150 stadia. He directed his course to the north-west, and, after sailing 150 stadia, reached a small sandy island called Crocala, now Chulna, or Chilni, which is situated off Cape Mouze, about five miles from the mainland. It is now described as a small desolate rock, about two miles in circumference, rising abruptly from the sea in a conical shape, to the height of about two hundred feet. Proceeding from Crocala, and having a mountain, which he calls Eiros, on his right, and a low sandy island on his left, he entered a large and safe harbour, which he designated Port Alexander. This is now called Sonmeany, and is said to be a creek running up some distance inland. Here he found that the south-west monsoon was still blowing with much fury, and he therefore remained quietly for twenty-three days. During his voyage for the next three hundred miles, he landed at many spots along the coast; and at the mouth of the Tomerus, or Tuburus, now called Busul, he had an engagement with the inhabitants, who assembled to the number of six hundred. He describes their bodies as in the most filthy state; their nails being so long and hard that they made use of them instead of iron, with which they were unacquainted. The people along this coast he calls Oreitæ, or Oræ, and states, that they had the same dress and arms as the Indians, but that their language and manners differed. A passage of 300 stadia then brought him to Malana, said to be still called Malin, which was the last spot belonging to the Oreitæ.

The whole of the remainder of the coast, to the vicinity of the entrance to the Persian Gulf, was inhabited by the Ichthyophagi or fish-eaters, a name which the Greeks gave to them on account of their mode of life. The country, to a considerable distance inland, was little else than a sandy desert, and the inhabitants supported themselves chiefly on the fish which they caught. From Malana Nearchus sailed 600 stadia to Bagisara, which he represents as a harbour fit for the reception of a fleet. It is now known under the name of Arabah or Hormarah Bay. The high rugged promontory which he passed immediately after leaving this place is now Cape Arabah. At the small island of Carninë, now Ashtola, he was hospitably received by the inhabitants, who supplied him with some sheep; but they found that even these animals tasted of fish, as well as the sea-birds which they caught. This island is represented as about four or five miles in circumference, and situated twelve miles from the coast of Mekran; but not a vestige of any habitation now remains. Proceeding 350 stadia, he reached an excellent harbour, which he calls Mosarna, where there were fishermen, and plenty of water, from the want of which they had suffered since they left the river Indus. This harbour was formed by a promontory projecting 150 stadia into the sea, now called Ras No, and the bay is that of Gwadel. Nearchus states, that he considered his dangers as now ended, and that the coast began to assume a much less desolate appearance. In 1150 stadia, he reached a small village, Barna, where there were palm trees, gardens with myrtles and flowers, and the inhabitants seemed to have some degree of cultivation. He began, however, to suffer from want of provisions; and having reached a small city, the only one he mentions in his voyage along this coast, he determined to compel the inhabitants to supply him with whatever they had. It is curious that the name of the city should not be mentioned; but having obtained possession of it by stratagem, he found that they had little else than flour made of the bones of fish ground to powder. He at length reached the end of the coast of the Ichthyophagi, which he describes as being 10,000 stadia in length. He now found himself on the coast of the fertile province of Carmania, and at Badis, now Jask, he obtained abundance of water and corn. On reaching Harmozia, at the mouth of the river Anamis, now called Minab, he discovered that Alexander was at no great distance with his army; and having landed, he proceeded to the camp, where he was received with great joy by the king and the whole army. He was directed to conduct the fleet up the Persian Gulf, to the mouth of the Euphrates, and reached the city Diridotis in safety. (See Notes on the Eastern Shores of the Persian Gulf in 1828, by Kempthorne, in the Geographical Journal, vol. v. p. 263; also the Voyage of Nearchus, illustrated by Dr Vincent, London, 1797; and *Recherches sur la Géographie des Anciens*, par Gosselin, vol. iii.)

Neas. NEAS, or NIAS ISLE. This island is situated on the west coast of Sumatra, from which it is separated by a strait sixty miles in breadth, and is fifty miles in length by twenty in average breadth. It is a large and productive island, and is divided into about fifty small districts, under chiefs or rajahs, who live in a state of perpetual hostility, their great object being to make prisoners, that they may sell them for slaves. These violences are encouraged by native traders, who resort to these islands for cargoes of slaves, and who are accused of occasionally surprising and carrying off whole families. The number of slaves exported is estimated at from 600 to 1000. Besides slaves, padi and rice are exported to a considerable amount. The cultivation of these articles is carried on at a distance from the coast, whither the natives retire, to be secure from piratical depredations. They bring down their produce to the harbours, and exchange it for iron, steel, beads, tobacco, and the coarser kinds of Madras and Surat piece-goods. Hogs are reared in great numbers; and several parts of the continent are supplied from thence with yams,

[1] Now the Behut or Bedusta, also called by the natives the Jylum, which still affords an abundant supply of timber.

bears, and poultry. It is well peopled, and its inhabitants are a peculiar and distinct race, not only from those of Sumatra, but from the people on all the islands to the southward. They are of lighter complexions, especially the women, than the Malays; smaller also in their persons, and shorter in their stature, with broad mouths, flat noses, and their ears pierced and distended in an extraordinary manner. They have a singular sort of leprous scurf on their skins, which in some covers the whole body and limbs, whilst in others it resembles rather the ring-worm running in waving lines or concentric curves. The principal food of the common people is rice, and the better classes use pork. The natives are remarkable for their docility and expertness in handicraft work, and are excellent house-carpenters and joiners. They are likewise industrious and frugal, temperate and regular in their habits, but at the same time avaricious, sullen, vindictive, and sanguinary. They are often employed by the Dutch as domestic servants; but they are always esteemed dangerous. In many cases, however, this may be owing to the bad treatment which they receive. Some of the petty rajahs in the island have amassed treasures to a considerable amount, equal to 10,000 or 20,000 dollars.

NEATH, a market-town of the hundred of the same name, in the county of Glamorgan, in South Wales, and distant 197 miles from London. The neighbourhood abounds in good coal, which is brought by canals from the pits to the navigable river Neath, and which forms an important branch of its commerce. There are, besides, several extensive works for smelting the copper ore produced on the opposite shore of Cornwall. About half a mile west of the town are the remains of its extensive and picturesque castle, and beyond it the cascade of Mellincourt, where the river Clydaugh precipitates itself over rocks of eighty feet perpendicular height. It is a corporate town, under a portreeve and twelve aldermen, but has never sent members to the House of Commons. It has a well-supplied market on Wednesday. The population amounted in 1801 to 2502, in 1811 to 2740, in 1821 to 2823, and in 1831 to 4043.

NEBULY, or NEBULEE, *in Heraldry*, is when a coat is charged with several little figures, in form of words running within one another, or when the outline of a bordure, ordinary, or the like, is indented or waved.

NECESSITY, whatever is done by a cause or power that is irresistible. In this sense it is opposed to freedom. Man is a necessary agent, if all his actions be so determined by the causes preceding each action, that not one past action could possibly not have come to pass, or have been otherwise than it has been; or if it be so ordained that any future action cannot possibly not come to pass, or be otherwise than it shall be. But he is a free agent if he be able, at any time, to do different things; or, in other words, if he be not unavoidably determined in every point of time, by the circumstances in which he is placed, and the causes to the action of which he is exposed, to do that one thing which he does, and not possibly to do any other thing. Whether man is a necessary or a free agent, is a question which has been debated with much ingenuity by writers of the first eminence. (See METAPHYSICS, part iii. chap. v.; and also PREDESTINATION.)

NECESSITY, in *Mythology*, a power superior to all other powers, and equally incapable of being resisted by gods or men. Herodotus, as quoted by Cudworth, mentions an oracle which declared that "God himself could not shun his destined fate;" and amongst the fragments of Philemon, collected by Le Clerc, we find the following sentence:

Δουλοι βασιλεων ἐσμεν, οἱ βασιλεις θεων, ὁ θεος ἀναγκης.

"We are subject to kings, kings are subject to the gods, and God is subject to Necessity." Hence it is that, in the Iliad, we find Jove himself, the sire of gods and men, regretting that he was restrained by Necessity from rescuing his favourite son from the sword of Patroclus. Nay, to such a height was this impiety carried in the earliest ages of Greece, that we find Hesiod and Homer teaching that the gods themselves were generated by Necessity engendering with Night and Chaos.

This power, although always represented as blind and unintelligent, was, however, worshipped as a goddess, bearing in her hand large iron nails, and wedges, and anchors, and melted lead, as emblems of the inflexible severity of her nature. In the city of Corinth she had a temple, in which the goddess of Violence likewise resided, and into which no person was ever permitted to enter except the priest who officiated *in sacris*.

Learned men have exercised their ingenuity in vain attempts to trace this portentous notion to its origin. Some, who wished to interpret it in a pious sense, have supposed that the gods who are subject to necessity were only those who were the ministers of the supreme *numen;* and that by necessity itself nothing more was meant than divine providence. But this is not consistent with the generation of the gods according to Homer and Hesiod, nor with the epithets *sæva necessitas, dura necessitas*, by which this power was perpetually distinguished. Others, amongst whom may be mentioned Mosheim, have supposed that this monstrous fable was invented by the Pagan priests, and diligently inculcated upon the minds of the people, to excuse the villanies of the objects of their worship.

NECHO, a king of Egypt, who began his reign 690 before Christ, and was killed eight years afterwards by Sabacon king of Ethiopia. Psammeticus his son succeeded him, and was the father, as Herodotus informs us, of Necho II. who reigned about 616 before Christ. This Necho II. is celebrated in history for attempting, though in vain, to cut a canal from the Nile to the Arabian Gulf. He carried his arms as far as the Euphrates, and conquered the city of Carchemish. This prince is not only known in Scripture, but also in profane history, under the name of Necho. He had no sooner succeeded to the crown than he raised great armies, and fitted out vast fleets, as well upon the Mediterranean as upon the Red Sea; he gave battle to the Syrians near the city of Migdol, and having routed them, made himself master of the city of Cadytis. The learned, however, are not agreed respecting this city of Cadytis. Some conceive it to have been Cades in Arabia Petræa, others Jerusalem, and others the city of Cedes, or Kedesh, in Galilee, in the tribe of Naphtali.

The Scriptures inform us of the expedition of Necho in all its particulars (2 Kings, xxiii. 29, &c.; and 2 Chronicles, xxxv. 20, 21, &c.). In the year of the world 3394, this prince having drawn out his army into the field in order to make war with the Assyrians or Babylonians, and to take the city of Carchemish, otherwise called *Circusium*, upon the Euphrates, Josiah king of Judah, who was a tributary to the king of Babylon, marched to oppose his passage. Necho, who had no designs against Josiah, sent to remonstrate with him. "What have I to do with you, king of Judah? It is not against you that I am come forth, but against another people, against whom the Lord has commanded me to make war. Leave off, therefore, to set yourself against me, for fear the Lord should punish you for your resistance." But Josiah would not hearken to the remonstrances of Necho, and gave him battle at Megiddo, where he received the wound of which he died. The people of Jerusalem set up Jehoahaz as king of Judah, and Necho soon advanced, without making any longer stay in Judæa.

But at his return from his expedition, which proved very successful, he halted at Riblah in Syria; and send-

Necker.

ing for Jehoahaz the king of the Jews, he there deposed him, loaded him with chains, and carried him into Egypt. Then marching to Jerusalem, he set up Eliakim, or Jehoiakim, in his stead, and exacted the payment of an hundred talents of silver and one talent of gold from the country. Jeremiah (xlvi. 2) informs us that the city of Carchemish was taken from Necho, by Nebuchadnezzar king of Babylon, in the fourth year of Jehoiakim king of Judah; and Josephus adds, that the king of Babylon, pursuing his victory, brought under his dominion all the country which is situated between the Euphrates and Egypt, excepting Judæa. Thus Necho was again reduced within the limits of his own country.

NECKER, James, a well-known statesman and financier of France. He was born on the 30th of September 1732, at Geneva, being descended of a respectable family, originally from the north of Germany. At the age of fifteen he quitted Geneva, and proceeded to Paris with a view to push his fortune in that city. He entered first into the banking-house of Vernet, and afterwards into that of Thelluson, of which he became the cashier, and at length a partner. On the death of Thelluson, he established a bank on his own account, by which he accumulated a very large fortune. After twenty years of unremitting attention to business, he married a Protestant lady of respectable family, but in reduced circumstances, the patrimonial estate having been lost in consequence of the revocation of the edict of Nantes. With this lady he appears to have enjoyed the highest degree of domestic happiness. A short time after his marriage, he was named minister of the republic of Geneva at Paris. In accepting of this employment he refused the emoluments which were attached to it, a degree of forbearance not very usual in public men, but in which he resolutely persisted during the whole course of his political life. Two works which he published, namely, an Eulogium on Colbert, and a treatise on the Legislation and Trade of Corn, greatly extended the reputation of his political talents; and he had fortunately succeeded in adjusting some differences between the East India Company and the crown, in such a manner as to receive the approbation of both parties, a circumstance which added to the weight of his character.

About this time the disorder in the state of the French finances had become so alarming, that it was found necessary to break through the routine of official promotion, and to choose able men for the public service wherever they could be found. These inducements so far outweighed the objections to M. Necker, as a foreigner and a Protestant, that, after some conversations with M. Maurepas, he was, in the year 1776, appointed director of the royal treasury, and, in the following year, director-general of the finances. The great object of M. Necker was to introduce order and economy in the public management. With this view he found himself compelled either to suppress useless offices, or to diminish emoluments; and his retrenchments drew upon him the enmity of all those who suffered by his economical reforms. A party was formed against him, chiefly composed of rapacious courtiers; and though the repeal of several most oppressive imposts had conciliated the general good will of the people, he was daily the object of malicious libels. His severe measures of economy had also excited the dislike of the minister M. Maurepas, although others ascribe his hostility to a different cause, namely, to his disappointment at not finding in Necker that subserviency which he expected from a person of his comparatively obscure origin, and a Protestant. Whatever was the reason, the minister was amongst the number of his enemies; and he is charged by Madame de Staël with secretly instigating those libellous attacks of which M. Necker now became the object. To enable him, according to Madame de Staël, the better to struggle with his opponents, he requested some signal mark of royal favour, such as a seat in the council, which was granted. This demand on the part of Necker gave rise to new and acrimonious discussions, in the course of which he tendered his resignation, after having been five years in office. Others give a different account of this transaction. Under the influence, it is said, of that passion for popular applause, which proved the torment of his life, he published, in 1781, the well-known piece on the state of the finances, entitled *Le Compte Rendu au Roi*, of which an immense number of copies were sold. Elated by this success, he made a demand for a seat in the council, but was objected to on the ground of his religion. Being persuaded that this scruple would be abandoned, he persisted, and offered his resignation, which was accepted; and in this manner, as is alleged, he became the dupe of his own presumption.

The enemies of Necker reproached him with indulging, during his short administration, his passion for popularity at the expense of the public interest. The great point which he laboured to establish in his *Compte Rendu* was, that there was no deficit in the public revenue, and that there was no necessity for additional taxes. In lieu of new impositions, he is charged with supplying the public necessities by the expedient of large loans; postponing, in this manner, the evil day, but accumulating on posterity an increasing load of debt, which, sooner or later, must be provided for by adequate taxes, and all this to procure a temporary popularity at the expense of his rivals. Notwithstanding these objections, he had numerous partisans, especially amongst the men of letters, who regarded his elevation to power as the triumph of philosophy and liberal principles over aristocratical prejudice.

After his resignation, he retired to Switzerland, where he purchased the barony of Coppet. In 1784 he published an able work, further illustrating his financial policy, entitled *De l'Administration des Finances.* This work, of which 80,000 copies were speedily sold, served to support the reputation of his plans, and also to keep together his adherents, whose numbers formed a counterpoise to the influence of his enemies at court.

In 1787 M. de Calonne convoked the Assembly of the Notables, and, in his opening speech to that body, impeached the accuracy of the statements contained in the *Compte Rendu.* It was not to be supposed that M. Necker would quietly submit to this charge. He sent a memorial upon the subject to the king, with various other papers, for the purpose of proving the correctness of his calculations. His majesty having read these documents, requested that they might not be published, a proposition which by no means suited the views of M. Necker. His statements were accordingly printed, and for this offence he was exiled, by a *lettre de cachet*, forty leagues from Paris.

M. de Calonne did not, however, remain long in power; and the Archbishop of Toulouse, by whom he was succeeded, was also obliged to resign, and to make way for M. Necker, the favourite of the people, who was reinstated in his former post in August 1788. A new and remarkable era was now about to open in the history both of France and of the world. The writings of the French philosophers and men of letters had gradually given currency to notions of constitutional freedom. The people could no longer endure, like their forefathers, the bondage of feudal privileges, by which the few acquired the power of oppressing the many. They had become jealous and discontented, and were deeply irritated at the insolence and oppression of the aristocratical body; and with those indignant feelings were mingled, in the minds of the popular leaders, the brilliant visions of speculative reform. But as long as the people wanted a legitimate organ through which their voice could be heard, it was clear that what-

Necker. ever might be their feelings, they could make little impression on the measures of the state. What was wanting in this respect was now about to be supplied; and the popular voice, hitherto so little considered, was, through the representative body, to become the pre-eminent influence in the government. At this period the French government was assailed by a complication of difficulties, the chief of which was the impracticability of raising the necessary supplies, and the danger of an immediate bankruptcy. A great scarcity also prevailed at Paris, which rendered the populace unusually discontented and tumultuous. In this emergency various expedients were suggested; and the convocation of the states-general, which had long been talked of, was advised by M. Necker, as likely to give general satisfaction to the people. In assenting to this proposition, it was the plan of the court that the different orders of the clergy, nobility, and commons, should vote in separate chambers, in order that the deputies of the commons might be controlled by the other two bodies. But the popular leaders were by far too penetrating to allow their influence to be annihilated by this device. They determined, from the beginning, that the three orders should sit and vote together; and it is well known that, after various fruitless efforts to bring about this union, the commons resolved to form themselves into an assembly for the despatch of business, without regard to the other two chambers. This decisive step proved effectual, and the three chambers at length all met and voted in one house, by which the whole power was thrown into the hands of the commons.

During these transactions, the king and his advisers pursued a weak and vacillating policy. They perceived, when it was too late, the error they had committed, or supposed themselves to have committed, in putting into the hands of the people the powerful weapon of a representative body. But instead of yielding to the necessity of circumstances, and conciliating this new power, which could no longer be resisted, by conceding with a good grace every just demand of constitutional right, they endeavoured to recover the ground which they had for ever lost, vainly struggling against the power of the commons, and meditating even the most violent measures for the recovery of their authority. It was in pursuance of these views that troops were drawn from the most distant parts, and encamped around Paris; a measure, the only construction that could be put upon which was, that it was intended to overawe the deliberations of the assembly, or, perhaps, to dissolve it at once at the point of the bayonet. These violent courses M. Necker opposed, and he was accordingly dismissed on the 11th of July 1789, and ordered to quit the kingdom in twenty-four hours. This order he obeyed with equal secrecy and despatch, and had arrived at Brussels before it was generally known in Paris that he was out of office.

It is impossible to describe the consternation which prevailed in the capital when the dismission and exile of this favourite minister was made known. The person who first communicated the intelligence was considered as a madman, and with difficulty escaped some harsh treatment; and the event was no sooner confirmed, than all the shops and places of amusement were shut up, and his bust, along with that of the Duke of Orleans, was paraded through the streets, dressed in mourning. These proceedings were interrupted by a German regiment; the busts were broken in pieces; and in the course of the tumult one man lost his life, whilst others were wounded. Fresh troops arriving, a serious conflict now ensued; and an old man being cut down in the Tuilleries by an officer of distinction, the populace were enraged to the highest pitch, and being joined by the French guards, who deserted their officers, they at last succeeded in overpowering the Germans. New outrages and tumults succeeded; the Bastille was stormed; and the capital became the scene of bloody massacres, whilst the people's minds were at the same time filled with dismay at the near approach of foreign troops, from whom they apprehended nothing less than the sack of the city. In the midst of these alarms, they beseeched the assembly to intercede with the king for the recall of their favourite minister. The necessity of complying with this demand was at length perceived by the king, and a letter was written to M. Necker, requesting him to return.

M. Necker was at Basle when he received this letter, with the request contained in which he resolved immediately to comply. His progress to Paris was one continued triumph. He was cheered as he passed through the different towns by the acclamations of multitudes, who hailed him as their deliverer. This popularity, however, was not of long duration. Being alarmed by the excesses which had already taken place, M. Necker became desirous to support the authority of the sovereign; and, without conciliating the confidence of the king's friends, he lost that of the popular party. By the royalists he was always hated; he now became an object of suspicion to the more violent patriots, and was reproached as an aristocrat. Seeing his popularity on the decline, he resolved to retire; and he accordingly wrote a letter to the assembly, pleading the necessity of repose for the restoration of his health. No notice was taken of this letter; and his personal safety being now in danger from the violence of the people, he quitted Paris in the month of December 1790, having withdrawn in the most private manner possible.

After the loss of his power and popularity, M. Necker seems to have sunk into the greatest dejection. "I could have wished," says Mr Gibbon, who passed some days with him about this period, "to have exhibited him as a warning to any aspiring youth possessed with the demon of ambition. With all the means of private happiness in his power, he is the most miserable of human beings; the past, the present, and the future, are equally odious to him. When I suggested some domestic amusements, he answered with a deep tone of despair, 'In the state in which I am, I can feel nothing but the blast which has overthrown me.'"

But his mind was soon diverted from the disappointments of ambition by domestic griefs of a more poignant nature; his wife, to whom he was deeply attached, dying after a long illness, in which he attended her with great affection. He had now recourse to writing to divert his melancholy; and several works, which he published, were the fruits of his labours. He died at Coppet, on the 9th of April 1804, after a short but painful illness. His public character is, of course, differently estimated, according to the political views of parties. In his private and domestic relations he was amiable and affectionate, and appears to have been greatly beloved.

His writings, besides those already mentioned, are the following: An Answer to the Memorial of the Abbé Morellet, on the East India Company, 1769; Memorials on the Provincial Administrations, 1781; Answer to the Speech pronounced by M. de Calonne to the Assembly of Notables, 1787; New Explanations on the Compte Rendu, 1788; Of the Importance of Religious Opinions, 1788; Observations on the Introduction to the Red Book, 1790; On the Administration of M. Necker, by Himself, 1791; On the Executive Power in Great States, 1791; On the French Revolution, 1796; Course of Religious Morality, 1800; Last Views of Politics and Finance. (See *Dictionnaire Universelle*, article NECKER; *Biographie Universelle*, article NECKER; *Mémoires sur la Vie Privée de mon Père*, par Madame la Baronne de Staël-Holstein, suivis des *Mélanges de M. Necker.*)

NECKER ISLES, a group of small islands in the South Pacific Ocean, nine in number. They were discovered and so denominated by Perouse. The principal island is about 500 toises in length, and sixty in elevation. Long. 162. 32. W. Lat. 23. 31. N.

NECROLIUM, a word used by some of the alchemist writers to express a remedy almost always capable of averting death, and continuing life to its utmost period.

NECROLOGY (*necrologium*, formed of νεκρος, *dead*, and λογος, *discourse*), a book anciently kept in churches and monasteries, in which were registered the benefactors of the same, the time of their deaths, and the days of their commemoration; as also the deaths of the priors, abbots, religious, canons, and other persons. This was likewise called *calendar* and *obituary*.

NECROMANCY, the art of revealing or foretelling future events by a pretended communication with the dead.

This most superstitious and impious imposture appears to have had its origin at an early period in Egypt, and to have been thence propagated in every nation with the manners of which history has made us acquainted. The conquests of Sesostris might introduce it into India; the Israelites would naturally borrow it from the people amongst whom they sojourned four hundred years; and it would easily find its way into Phœnicia, from the vicinity of that country to the land of its nativity. From the Egyptians and Phœnicians it was adopted, with the other rites of paganism, by the Greeks; and with Grecian literature and Grecian manners it was imported into Rome. It was not, however, confined to the pagan nations of antiquity. It spread itself throughout all the modern nations of Europe, and took such deep root as to be long retained even after those nations had been converted to the Christian faith.

Of its early antiquity we have complete evidence in the writings of Moses, where it is severely condemned as an abomination to the Lord; and although it appears to have even then spread into Phœnicia, we might yet conclude that its birthplace had been Egypt, because, at their exod, the Israelites were corrupted only by Egyptian superstitions, and because necromancy seems to have been one of those whoredoms which the prophet Ezekiel represents his countrymen as having brought with them from Egypt, and continued to practise until they were carried as captives into Babylon.

If from sacred we proceed to consult profane authors, we shall find them not only affirming that Egypt had been the birthplace of necromancy, but in some degree accounting for the origin of so impious a delusion. From Diodorus we learn that the Grecian fable of Charon the ferryman of hell, of Styx, Cocytus, the Elysian Fields, Tartarus, the judgment of Minos and Rhadamanthus, &c. with the whole scenery of the infernal regions, were imported from Egypt into Greece. The ancient Egyptians, and indeed all the people of the East, made use of caves as burying-places; which were well suited to the solemn sadness of surviving friends, and proper receptacles for those who were never more to behold the light. In Egypt, many of these subterranean cavities being dug out of the natural rock, still remain, and command the admiration of travellers; and near to the pyramids in particular there are some apartments of a wonderful fabric, which, though they extend in length upwards of four thousand feet, and are about thirty feet in depth, appear to have been, if not entirely dug, at least reduced to form, by the chisel or the pick-axe of the artist.

From the practice of burying in such caverns sprung the opinion that the infernal mansions were situated somewhere near the centre of the earth, which by the Egyptians was believed to be not very distant from its surface. In these dreary abodes, it was easy for such adepts as the priests of Egypt to fabricate Erebus, and Tartarus, and the Elysian Fields, and all those scenes which were displayed before the initiated (see MYSTERIES), and by them described to the millions of the people. As it was in those dark abodes that necromancy was practised, it would be no difficult matter for such magicians as withstood Moses, to impose so far upon the credulous vulgar as to make them believe, that in consequence of their invocations they actually saw the ghosts of their friends ascend out of the earth. It appears from the book of Exodus, that the Israelitish women were, even in the wilderness, well acquainted with the use of the mirror, which was therefore undoubtedly known to the Egyptians. But a mirror of a particular form, and properly illuminated at the instant required, might be easily made to reflect, in a cavern from which all other light was carefully excluded, the image of the deceased, when called upon by the necromancer; and we can also readily conceive, that with respect to the question to be proposed, a person might be concealed, prepared to give such ambiguous answers as would satisfy the inquirer, and at the same time to save the credit of the oracle. The terrified imaginations of the spectators would aid the delusion, and make a very slight resemblance pass for the ghost or εἰδωλον of their departed friend; or the necromancer might assign plausible reasons why a spectre, after having dwelt for some time in the infernal regions, should lose something of its resemblance to the body which it animated. Such juggling tricks, though performed by artists less accomplished than Jannes and Jambres, have gained credit amongst people much more enlightened than the Egyptians can possibly have been when the science of necromancy was invented by their priests.

That the Israelites, notwithstanding the prohibition of their legislator, continued to practise the rites of necromancy, is apparent from Saul's transaction with the witch of Endor. From the same transaction, it is likewise apparent that the witches of Israel, and therefore in all probability the necromancers of Egypt, pretended to evoke the ghosts of the dead by a demon or familiar spirit, which they had at their command to employ upon every emergency. This demon was called OB; and therefore Saul desires his servants to find him a woman who was mistress of an OB.[1] It is probable that those wretched impostors had in their pay some persons who occasionally acted the part of the demon, and, when the execution of the plot required their agency, emitted, by means of a cavity dug for that purpose, a low hollow voice from below the ground. Hence we find Isaiah, in his denunciations against Ariel, saying, "Thou shalt be brought down, and shalt speak out of the ground; and thy speech shall be low out of the dust, and thy voice shall be as one that hath a familiar spirit

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[1] The original or radical signification of this word occurs in Job (xxxii. ver. 19), where Elihu compares his belly to new bottles, which he calls *oboth*, the plural of *ob*. But as bottles were then made of leather, new bottles filled with wine and ready to burst, as Elihu describes them, would of course be of a form nearly globular. Hence it may be inferred that the original import of *ob* was *round* or *globular*; but *b* and *p* being labials, are often changed into each other; and, therefore, from the Hebrew *ob* is derived the Greek 'ὀψ, *oculus*, ὀπτομαι, *video*, and the Latin *ops*, a name under which the earth was worshipped. *Upis* was a name of Diana or the moon: the father of one of the Dianas was likewise *Upis*; but this *Upis* was undoubtedly the sun. Now the difference between *upis* and *opis* is nothing; and hence we are led to believe, that as they are all derived from *ob*, this word was employed by the early idolaters of Egypt to denote the first and greatest of Pagan gods, the Sun. If so, those wretches who pretended to be mistresses of *obs* were exactly the same kind of impostors with the Pythonesses of the Greeks.

(an OB), out of the ground, and thy speech shall whisper out of the dust."

But although the Egyptian priests were undoubtedly the inventors of the whole mystery of necromancy, and although it was from them imported into Greece by the Selli or priests of Dodona, it does not appear that the Grecian necromancers pretended to be masters of OBS or familiar spirits. Mopsus, Orpheus, Linus, Eumolpus, and others, who either travelled into Egypt in quest of knowledge, or were actually natives of that country, instructed the early Greeks in this occult science; but whatever might be the practice of these apostles themselves, their disciples professed to do all the feats of magic by performing certain rites, by offering certain sacrifices, by muttering a certain form of words, and by charms, spells, and exorcisms. By these they pretended to evoke the dead as certainly as the Egyptians and Jews did by their familiar spirits. By a small display of critical learning this might easily be proved from the popular story of Orpheus and Eurydice, which certainly was founded on one of these necromantic deceptions exhibited in a cave near Dodona, where the priests had a *hades* or infernal mansion, in humble imitation of those with which the first of them were well acquainted in Egypt. It is indeed evident, without the aid of criticism; no man of any letters can be ignorant, that whatever superstitions of this kind prevailed amongst the Romans were borrowed from the Greeks. But we all know that Virgil makes one of his shepherds, by means of certain herbs, poisons, and senseless charms, raise up ghosts from the bottoms of their graves; and Lucian has fabricated a story of this kind, which may be considered as an exact parallel to that of the witch of Endor. Just before the battle of Pharsalia he makes young Pompey travel by night to a Thessalian sorceress, and anxiously inquire of her the issue of the war. This female necromancer, by a tedious process of charms and incantations, conjures up the ghost of a soldier who had been recently slain. The phantom, after a long preamble, denounces a prediction much of the same kind with that which the king of Israel received from Samuel at Endor; and though we have elsewhere shown, that nothing but the spirit of God could have foreseen the inevitable destruction of Saul, his sons, and his army, it was very easy for any man of tolerable sagacity to foresee the defeat of Pompey's raw and undisciplined troops by the hardy veterans of the victorious Cæsar.

It would be endless to enumerate all the fallacious evocations of ghosts, and the ambiguous responses returned by those pretended spirits, of which we have received accounts from the poets and historians of the celebrated nations of antiquity. We shall therefore proceed to mention a few which occur in the fabulous history of more modern nations, and then leave the subject to the meditation of our readers. In Mallet's Northern Antiquities we have the following account of a necromantic exploit, between which and the descent of the ancient heroes into hell it is impossible not to remark a striking similitude.

Odin, the sovereign of man, arises. He saddles his horse Sleipner; he mounts, and is conveyed to the subterranean abode of *Hela*. The dog which guards the gates of death meets him. His breast and his jaws are stained with blood. He opens his voracious mouth to bite, and barks a long time at the father of magic. Odin pursues his way; and the infernal cavern resounds and trembles under his horse's hoofs. At length he reaches the deep abode of death, and stops near the eastern gate, where stands the tomb of the prophetess. He sings with a voice adapted to call up the dead; he looks towards the world; he engraves Runic characters upon her tomb; he utters mysterious words; and he demands an answer, until the prophetess is constrained to arise and utter the words of the dead. "Who is this unknown that dares to disturb my repose, and drag me from the grave, in which I have been dead so long, all covered with snow, and moistened with the rain?"

The Gaelic druids pretended to be masters of the same secret. This is evident from the name of a species of divination called *taghairm*, not uncommon amongst the Scotch Highlanders so recently as in the beginning of the eighteenth century. This word seems to be compounded of *ta*, which in some parts of the Highlands is still used to denote a spirit or ghost, and *ghairm*, which signifies calling upon or invoking. *Taghairm*, therefore, in its original import, is necromancy in the most proper sense of that word.

There were different kinds of *taghairm*, of which one was practised in Skye. The diviner covered himself with a cow's hide, and repaired at night to some deep-sounding cave, whither the person who consulted him followed soon afterwards without any attendants. At the mouth of the cave he proposed aloud the questions of which he wanted solutions; and the man within pronounced the responses in a tone of voice similar to that with which the OBS, or pretended demons of antiquity, gave from beneath the ground their oracular answers. That in the latter days of *taghairm*, the Gaelic diviners pretend to evoke ghosts, and from them to extort solutions of difficulties proposed, we have no positive evidence; but that such was the original pretence there can be little doubt, when we reflect either upon the place where this species of divination was practised, or upon the import of the word by which it was denominated.

NECROPOLIS, a suburb of Alexandria, in Egypt. It signifies the City of the Dead, and was the place where temples, gardens, and superb mausoleums were erected. Here Cleopatra is said to have applied the asp to her breast, to prevent her being led in triumph by Augustus, who endeavoured to save her.

NECROSIS, νεκρωσις, in *Medicine*, a complete mortification of any part. It is also called *sideratio* and *sphacelus*.

NECTANEBUS, or NECTANABIS, a king of Egypt, who bravely defended his country against the Persians. His grandson of the same name formed an alliance with Agesilaus, king of Sparta, and with the assistance of that prince he quelled a rebellion of his subjects. Some time afterwards, he was joined by the Sidonians, Phœnicians, and inhabitants of Cyprus, who had revolted from the king of Persia. This powerful confederacy was soon attacked by Darius, the king of Persia, who marched at the head of his troops. Nectanebus, to defend his frontiers against so dangerous an enemy, levied twenty thousand mercenary soldiers in Greece, the same number in Libya, and sixty thousand were furnished in Egypt. But this numerous body was not equal to the Persian forces, and Nectanebus, being defeated in battle, gave up all hopes of resistance, and fled into Ethiopia, where he found a safe asylum. From that time the kingdom of Egypt became tributary to the king of Persia.

NECTAR, amongst ancient poets, the drink of the fabulous deities of the heathens; in contradistinction to their solid food, which was called *ambrosia*.

NECTARINE, a fruit differing in nothing from the common peach, of which it is a species, but in having a smoother rind and a firmer pulp.

NECTARIUM, from *nectar*, the fabled drink of the gods, is defined by Linnæus to be a part of the corolla, or appendage to the petals, appropriated for containing the honey, a species of vegetable salt under a fluid form, which oozes from the plant, and is the principal food of bees and other insects.

But notwithstanding this definition, which seems to consider the nectarium as necessary a part of the corolla as the petals, it is certain that all flowers are not provided with this appendage, neither indeed is it essential to fructifica-

Nectarium. tion. There is, besides, a manifest impropriety in terming the nectarium a part of the corolla. Linnæus might, with equal propriety, have termed it a part or appendage of the stamina, calyx, or pointal, as the appearance in question is confined to no particular part of the flower, but is as various in point of situation as of form. The truth is, the term *nectarium* is exceedingly vague, and, if any determinate meaning can be affixed to it, is expressive of all the singularities which are observed in the different parts of flowers.

The tube or lower part of flowers with one petal Linnæus considers as a true nectarium, because it is generally found to contain the sweet liquor formerly mentioned. This liquor Pontedera compares to that called *amnios* in pregnant animals, which enters the fertile or impregnated seeds; but that this is not at least its sole use, is evident from the circumstance, that the honey or liquor in question is to be found in flowers where there are either no seeds, or such as, from the want of male organs, cannot be impregnated. Thus the male flowers of nettle and willow, the female flowers of sea-side laurel and black bryony, the male and female flowers of clutia, kiggelaria, and butcher's broom, all abound with the honey or nectar alluded to.

Vaillant was of opinion that the nectarium formed an essential part of the corolla; for which reason he distinguished the singular appearances in fennel flower and columbine by the name of *petals*. The coloured leaves which are now termed *petals* he denominated the *flower-cup*. That the nectarium, however, is frequently distinct from the petals, is evident both from the well-known examples just mentioned, and likewise from the flowers of monkshood, hellebore, isopyrum, fennel flower of Crete, barrenwort, grass of Parnassus, chocolate nut, cherleria, and sauvagesia.

These general observations being premised, we proceed to take a nearer and more particular view of the principal diversities, both in form and situation, of this striking appendage of the flower. 1. In many flowers the nectarium is shaped like a spur or horn; and that either in flowers of one petal, as valerian, water milfoil (*utricularia*), butterwort, and calves-snout; or in such as have more than one, as larkspur, violet, fumitory, balsam, and orchis. 2. In the following plants, the nectarium is properly a part of the corolla, as lying within the substance of the petals: Ranunculus, lily, iris, crown imperial, water-leaf, mouse-tail, ananas or pine-apple, dog's-tooth violet, piperidge bush, vallisneria, hermannia, uvularia, and swertia. 3. The nectarium is frequently placed in a series or row within the petals, though entirely unconnected with their substance. In this situation it often resembles a cup, as in narcissus. A nectarium of this kind is said by Linnæus to crown the corolla. The following are examples: Daffodil, sea daffodil, campion, viscous campion, swallow-wort, stapelia, cynanchum, nepenthes, cherleria, balsam-tree, African spiræa, witch-hazel, olax, and passion-flower. 4. In Indian cress, buckler, mustard, Barbadoes cherry, and monotropa, the nectarium is situated upon or makes part of the calyx. 5. The nectarium in bastard flower-fence is seated upon the antheræ or tops of the stamina; whence the name *adenanthera*, or *glandular anthera*, which has been given to this genus of plants. In the following it is placed upon the filaments: Bean-caper, bay, fraxinella, marvel of Peru, bell-flower, lead-wort, roella, and commelina. 6. In hyacinth, flowering-rush, stock July flower, and rocket, the nectarium is placed upon the seed-bud. 7. In honey-flower, orpine, buck-wheat, collinsonia, lathræa, navelwort, mercury, clutia, kiggelaria, sea-side laurel, and African spiræa, it is attached to the common receptacle. Lastly, In ginger, nettle, dyer's weed, heart-seed, costus, turmeric, grewia, bastard orpine, vanelloe, shew-tree, and willow, the nectarium is of a very singular construction, and cannot properly fall under any of the foregoing heads.

In discriminating the genera, the nectarium often furnishes an essential character.

Plants which have the nectarium distinct from the petals, that is, not lodged within their substance, are affirmed by Linnæus to be generally poisonous. The following are adduced as examples, viz. monkshood, hellebore, columbine, fennel-flower, grass of Parnassus, barren-wort, oleander, marvel of Peru, bean-caper, succulent swallow-wort, fraxinella, and honey-flower.

Nedjed. NEDJED, a central province of Arabia. The name signifying high or elevated ground, is applied to this country in opposition to Tchama, or "low lands," which is applied to the tracts of low land along the coast by which the border of high land in Arabia is encompassed. It is described by Burckhardt as an oblong tract, extending between three and four days' journey from west to east, and two journeys in breadth from south to north. It is a cultivated territory, the most populous portion of Arabia, irrigated by many ancient wells lined with stone, which are ascribed by the inhabitants to a primeval race of giants. These wells are from twenty-five to thirty fathoms deep, being mostly the property of individuals, who exact a certain contribution from the tribes whose cattle they supply with water. Within this province there are above twenty-six small towns or villages. The chief town is Bereyda, where the sheikh resides. Under the Wahabees Derayah became a place of note. Nedjed is celebrated throughout Arabia for its excellent pastures, which, after rain, abound even in its deserts, and feed an excellent breed of camels, more numerous here than in any other of the Arabian provinces of equal extent. It is called the mother of camels, and Arabs resort to it from all quarters for the supply of their own herds; it also furnishes a constant supply, not only to Hedjaz, but to Syria and Yemen. A camel in Nedjed costs ten dollars. There is also an excellent breed of horses in this country, so remarkable that the finest blood Arab horses are properly denoted Nedjed horses. But the temporary ascendency of the Wahabees caused a diminution of the breed, as many of the Arabs sold their horses to foreign ports, lest they should be pressed into the service of the Wahabee chief, who frequently required cavalry. Nedjed is subject to scarcity, caused by the failure of rain, and consequently of herbage. This soon affects the cattle of the Bedouins, who seldom expect in this country more than three or four successive years of plenty, though absolute famine does not occur above once in ten or fifteen years. It is generally accompanied by epidemical diseases, much like the plague, consisting of violent fevers, which prove fatal to great numbers. Nedjed is peopled by small tribes of Bedouins, who never leave it, and by settlers intermarried with them, and often travelling as merchants to Damascus, Bagdad, Medina, Mekka, and Yemen. Here the pure manners of the Arabs continue unaltered by conquest, and retain all their original simplicity; nor have they been contaminated by an influx of strangers; for if we except the caravans of pilgrims travelling from Bagdad to Mekka, no foreigners ever pass through Nedjed. "For this reason," says Burckhardt, "I consider Nedjed and the mountains between Tayf and Sanaa as the most interesting portion of Arabia, affording more objects of inquiry to a traveller than any other part of the peninsula." Those who are settled here as travelling merchants export camels and woollen cloaks, of which the best are manufactured at El Hasse; and from Bagdad they receive rice, the produce of the banks of the Tigris, and articles of dress, especially the keffies or handkerchiefs, striped, green, and yellow, made of cotton, wool, or silk. The Bedouins wear these over their bonnets. From Mekka they obtain coffee, drugs, and perfumes, much used amongst them, particularly a perfume much valued which comes from Mocha. A spirit of commerce prevails generally amongst the inhabitants of Nedjed, where the merchants are wealthy, and of better repute for honesty than most of the eastern traders. The settlers are generally armed with matchlocks, and they constituted, during the ascendency of the Wahabee power, the best portion of their infantry. They are generally successful in repelling the inroads of the other wandering Arabs on their pastures. Saltpetre being abundant, every family makes its own yearly provision of gunpowder.

NEEDHAM, John Tuberville, was born at London on the 10th of September, in the year 1713. His parents were descended from ancient and noble families. His father, who had once possessed a considerable patrimony at Hilston, in the county of Monmouth, was of the younger and Catholic branch of the Needham family; whilst the head of the elder and Protestant branch was Lord Kilmory, created viscount in the year 1625. The father of Mr Needham died young, and left but a small fortune to his four children. His eldest son, who is the subject of this article, prosecuted his studies under the secular clergy of the English college at Douay, where he took orders, taught rhetoric for several years, gave eminent proofs of sagacity and genius, and surpassed all the other professors of that seminary in the knowledge of experimental philosophy. In 1740, he was engaged by his superiors in the service of the English mission, and was intrusted with the direction of the school erected at Twyford, near Winchester, for the education of the Roman Catholic youth. In 1744, he was appointed professor of philosophy in the English college at Lisbon, where, on account of his bad health, he remained only fifteen months. After his return, he passed at London and Paris several years, which were principally employed in microscopical observations, and in other branches of experimental philosophy. The results of these observations and experiments were published in the Philosophical Transactions of the Royal Society of London in 1749, and at Paris in 1750 in one volume 12mo; and an account of them was also given by M. de Buffon, in the first volumes of his Natural History. An intimate connection existed between the illustrious French naturalist and Mr Needham; they made their experiments and observations together, though the results and systems which they deduced from the same objects and operations were totally different. Mr Needham was admitted as a member of the Royal Society of London in the year 1747, and of the Antiquarian Society some time afterwards. From the year 1751 to 1767 he was chiefly employed in finishing the education of several English and Irish noblemen, by attending them as tutor in their travels through France, Italy, and other countries. He then retired from this wandering life to the English seminary at Paris, and, in 1768, was chosen by the Royal Academy of Sciences in that city a corresponding member.

When the regency of the Austrian Netherlands, desirous to promote the revival of philosophy and literature in that country, formed the project of an imperial academy, which was preceded by the erection of a small literary society to prepare the way for its execution, Mr Needham was invited to Brussels by the Count de Cobentzel and the president Neny, and was successively appointed chief director of both these foundations. He held this place, together with some ecclesiastical preferments he had obtained in the Low Countries, until his death, which happened on the 30th of December 1781. His piety, temperance, and purity of manners, were eminent; his attachment to the doctrines and duties of Christianity was inviolable. His opposition to modern infidels was indefatigable, and even passionate; but his probity was untainted. He was incapable of every species of duplicity; his beneficence was universal, and his unsuspecting candour rendered him often the dupe of perfidy.

The papers of Mr Needham, inserted in the Philosophical Transactions, are contained in vols. xlii. xliv. xlv. and li., and treat, 1. of tubulous concretions; 2. of worms in smutty corn, observed with the microscope; 3. of some electrical experiments made at Paris; 4. of Buffon's burning mirror; 5. of the generation, composition, and decomposition of animal and vegetable substances; and, 6. of the discovery of asbestos in France. Again, his works printed at Paris in French embrace, 1. New Microscopical Discoveries, 1745; 2. The same enlarged, 1750; 3. Observations on the Generation of Organized Bodies, 1769. He had also a considerable share in the well-known controversy respecting the origin of the Chinese, and adopted the opinion of M. de Guignes, that that people are descended from the ancient Egyptians and Phœnicians. (See the article Hieroglyphics.) He arrived at this conclusion from comparing the characters upon the breast and forehead of a bust in the museum of Turin, supposed to be of Egyptian origin, with those of a Chinese dictionary in the Vatican, which had been printed at Pekin, and from perceiving a considerable resemblance between the characters on the one and contained in the other. The result of his investigation he published in a pamphlet, entitled *De Inscriptione quadam Ægyptiaca Taurini inventa, et characteribus, Ægyptiis olim et Sinis communibus exarata*, 1761, in 8vo. Nothing could be fairer or more candid than the manner in which Mr Needham proceeded in comparing the characters on the bust with those in the dictionary; but the theory deduced from this comparison is nevertheless entirely groundless and imaginary. In all forms of hieroglyphical writing, such casual coincidences may easily be detected, because picture-writing is the original basis of each; and hence the existence of such resemblances affords no proof whatever of one nation being descended from, or in any way connected with, another. But there is scarcely any similarity between the Chinese characters and the Egyptian hieroglyphs. The former were originally mere rude delineations of external objects, which, in process of time, came to be variously combined and modified, until they assumed the peculiar forms in which we now find them. The latter, however, were constructed on a far more complex and artificial principle, and of their aggregate number only a small portion can be referred to picture-writing. To seek resemblances, therefore, amongst things so disparate, is rather to indulge the fancy than to prosecute rational inquiry.

Needham-Market, a town of the county of Suffolk, in the parish of Barking, and hundred of Bosmere-cum-Claydon, seventy-four miles from London. It is well built, has a market on Wednesday, and had formerly some manufactures of cloth, which are now abandoned. The population amounted in 1801 to 1348, in 1811 to 1301, in 1821 to 1300, and in 1831 to 1466.

NEEDLE, a very common little instrument, made of steel, pointed at one end, pieced at the other, and employed in sewing, embroidery, tapestry, and the like.

Needles form a very considerable article in commerce; and as there is scarcely any commodity cheaper, the consumption of them is almost incredible. The sizes vary from No. 1, the largest, to No. 25, the smallest. In the manufacture of needles, German and Hungarian steel is in general preferred.

In making this article, the first thing is to pass the steel through a coal fire, and under a hammer, to bring it out of its square figure into a cylindrical one. This being done, it is drawn through a large hole of a wire-drawing iron, and returned into the fire, and drawn through a second hole of the iron smaller than the first; and thus successively from hole to hole, till it has acquired the degree of fineness required for that species of needles; observing, every time it is drawn, that it be carefully greased over with lard, to render it more manageable. The steel, thus reduced to a fine wire, is cut in pieces of the length of the needles intended; and these pieces are flattened at one end on the anvil, in order to form the head and eye. They are then put into the fire to soften them farther, and thence taken out and pierced at each extreme of the flat part on the anvil, by force of a puncheon of well-tempered steel, and laid on a leaden block, to bring out, with another puncheon, the little piece of steel remaining in the eye. The corners are then filed off the square of the heads, and a little cavity is filed on each side of the flat of the head; the point is then formed with a file, and the whole filed over. They are next laid to heat red hot on a long narrow iron, crooked at one end, in a charcoal fire; and when taken out thence, they are thrown into a bason of cold water to harden. On this operation a good deal depends; too much heat burns them, and too little leaves them soft; the medium is only learned by experience. When they are thus hardened, they are laid in an iron shovel, on a fire more or less brisk, in proportion to the thickness of the needles, taking care to move them from time to time. This serves to temper them, and take off their brittleness; but great care must be taken as to the degree of heat applied. They are then straightened one after another with the hammer, the coldness of the water used in hardening them having twisted the greater part of them.

The next process is that of polishing them. To effect this, the workmen take twelve or fifteen thousand needles, and range them in little heaps against each other upon a piece of new buckram sprinkled with emery dust. The needles being thus disposed, emery dust is thrown over them, which is again sprinkled with oil of olives; at last the whole is made up into a roll, well bound at both ends. This roll is then laid on a polishing table, and over it a thick plank loaded with stones, which two men work backwards and forwards a day and a half, or two days successively; by which means the roll is continually agitated by the weight and motion of the plank over it, and the needles withinside, being rubbed against each other with oil and emery, are insensibly polished. After polishing, they are taken out, and the filth washed off them with hot water and soap; they are then wiped in hot bran, a little moistened, placed with the needles in a round box, suspended in the air by a chord, which is kept stirring till the bran and needles be dry. The needles being thus wiped in two or three different brans, are taken out and put in wooden vessels, to have the good separated from those whose points or eyes have been broken either in polishing or wiping; the points are then all turned the same way, and smoothed with an emery stone turned with a wheel. This operation finishes them, and there remains nothing but to make them up into packets of 250 each. Needles were first made in England by a native of India, in 1545, but the art was lost at his death; it was, however, recovered in 1560, by Christopher Greening, who settled with his three children at Long Crendon in Bucks, where the manufactory has been carried on from that time to the present day.

Dipping-Needle, or *Inclinatory Needle*, a magnetical needle, so hung that, instead of playing horizontally, and pointing out north and south, one end dips or inclines to the horizon, and the other points to a certain degree of elevation above it. See the article Magnetism.

Magnetical Needle, in *Navigation*, a needle touched with a loadstone, and sustained on a pivot or centre, on which playing at liberty, it directs itself to certain points in or under the horizon. See the article Magnetism.

Needles, sharp pointed rocks north of the Isle of Wight. They are situated at the western extremity of the island, which is a point of high land from which they have been disjoined by the washing of the sea. There were formerly three of these lofty white rocks, the tallest of which, called *Lot's Wife*, rose 120 feet above low-water mark, and in its shape resembled a needle; but being undermined by the constant efforts of the waves, it was thrown down, and totally disappeared.

NEEDWOOD FOREST, in Staffordshire, between the Trent, Dove, and Blythe, and near Uttoxeter, is said to exceed all the forests in England in the excellence of its soil and the fineness of its turf.

NEELAB, a town of Hindustan, in the province of Lahore, situated on the east bank of the Indus, and thirty miles south-south-west from Attock. Long. 70. 53. E. Lat. 32. 50. N.

NEELAHCUNDAH, a town of the Afghan territories, in the province of Lahore, on the Indus, forty-seven miles south-south-east from Attock. Long. 71. 49. E. Lat. 32. 38. N.

NEELGOUND, a fortress and district of the south of India, province of Bejapoor, situated on the Malpurba River. It is now included in the British territories.

NEELGUNGE, a town of Hindustan, in the province of Oude, in the vicinity of which indigo is produced in abundance; it is fourteen miles west by south from Lucknow. Long. 80. 42. E. Lat. 26. 47. N.

NE EXEAT REGNO, in English law, is a writ to restrain a person from going out of the kingdom without the king's license.

NEFASTI DIES, in Roman antiquity, an appellation given to those days in which it was not allowed to administer justice, or to hold courts. They were so called because *non fari licebat*, the prætor was not allowed to pronounce the three solemn words or formulas of the law, *do*, *dico*, *addico*, I give, I appoint, I adjudge. These days were distinguished in the calendar by the letter N. for *nefasti*; or N. P. *nefastus primo*, when the day was only *nefastus* in the forenoon, or first part. The days of a mixed kind were called *intercisi*.

NEGADA, more properly Anegada, the most northern of the cluster of islands known by the name of the Virgin Islands, in the West Indies, and unhappily celebrated for the number of shipwrecks, in many cases accompanied with a heavy loss of life, which it has occasioned. It was first permanently settled by individuals who hoped to reap considerable advantages by collecting the spoil of the vessels wrecked on its inhospitable shores. They found that the loose ground which covered it was capable of bearing provision crops, and even cotton; whilst the rearing of stock, and the sale of the underwood, which was progressively cleared away, and, being very full of gum, had a preference in the market of St Thomas, furnished a further resource. The great object, however, always has been the wreck of vessels; and the indolence of the inhabitants is only thoroughly roused by the cry of "a vessel on the reefs." The moment this is raised, all becomes activity and bustle. Boats and small craft of every description push off towards the scene of destruction, and both skill and intrepidity are exercised to the uttermost to get first on board. The surface of Anegada is the production of the tribe of *lithophytæ*, based, it is presumed, on a submarine elevation. The appearance of the island when approached is remarkable. First, single trees show themselves on the horizon; then the most elevated part of the island, called Frank's Landing, which may be descried eight miles off in clear weather; and, last of all, the lower land. Its greatest length is 10·07 English miles, and its greatest breadth, which is about the middle, 4·25 English miles; but it afterwards diminishes towards both extremities. The reef by which it is surrounded approaches nearest on the north side of the island, where at one point it unites with the shore. Generally speaking, the distance of the reef from the island is inconsiderable on the northern, western, and partly on the southern side. To the eye Anegada appears a dead flat, with only a turpentine or loblolly tree overlooking the underwood. However, the ground rises gradually from north to south, about sixty feet. There is some rather productive soil on the island, and a great number of ponds, which, in long-continued dry weather, produce considerable quantities of salt. There is abundance of fresh water; and the surrounding sea abounds with good fish, as do also the ponds. There are some rare specimens of plants in Anegada. The feathered tribes are very numerous; and there is an abundance of domestic animals. The population of Anegada consists at present of eleven white and twenty-one coloured and black families.

NEGAPATAM, a considerable seaport in the south of India, and province of Tanjore. It is well fortified, and has a regular citadel of a pentagonal form, with wet ditches. It has no considerable trade; but is frequently touched at by ships for refreshments, which are plentiful. The town lies at the north side of the citadel, near which is the mouth of a small river, capable of receiving vessels which draw little water. At the mouth of the river there is a bar, over which the surf breaks with great violence in bad weather, and renders the entrance dangerous. The anchoring place is about three miles from the shore, opposite the town, where there is very little current; and to the south-east of the town, at the distance of five miles, there is a shoal above five miles in length, having from three to six fathoms water on it. It was originally a small village, but was fortified and improved by the Portuguese. In 1660, it was taken from them by the Dutch, who strengthened its fortifications, and made it the capital of their settlements on the Coromandel coast, where they established a mint. Under their rule it enjoyed a long period of tranquillity; its trade increased, and it became a very flourishing city. In 1781 it was besieged and taken by the British with about 4000 troops, and was finally ceded to them at the peace of 1783; since which period the fortifications have been neglected, and the trade has been transferred to other places. Long. 79. 55. E. Lat. 10. 43. N.

NEGATION, in *Logic*, is an act of the mind affirming one thing to be different from another; as that the soul is not matter. See Logic.

NEGATIVE, in general, something which implies a negation. Thus we say negative quantities, negative powers, negative signs, and the like.

Negative Sign. The use of the negative sign, in algebra, is attended with several consequences which at first are admitted with difficulty, and has sometimes given occasion to notions which appear to have no real foundation. This sign implies, that the real value of the quantity represented by the letter to which it is prefixed is to be subtracted; and it serves, with the positive sign, to keep in view what elements or parts enter into the composition of quantities, and in what manner, whether as increments or decrements, that is, whether by addition or subtraction. It serves therefore to express a quantity of an opposite quality to the positive, as a line in a contrary position, a motion with an opposite direction, or a centrifugal force in opposition to gravity; and thus often saves the trouble of distinguishing and demonstrating separately the various cases of proportions, and preserves in view their analogy. But as the proportions of lines depend on their magnitude only, without regard to their position, and motions and forces are said to be equal or unequal, in any given ratio, without regard to their directions; and, in general, the proportion of quantity relates to their magnitude only, without determining whether they are to be considered as increments or decrements; so there is no ground to imagine any other proportion of $-b$ and $+a$ (or of -1 and 1) than that of the real magnitude of the quantities represented by b and a, whether these quantities are, in any particular case, to be added or subtracted. It is the same thing to subtract the decrement as to add an equal increment, or to subtract $-b$ from $a-b$, as to add to it $+b$. And because multiplying a quantity by a negative number implies only a repeated subtraction of it, the multiplying $-b$ by $-n$ is subtracting $-b$ as often as there are units in n; and is therefore equivalent to adding $+b$ so many times, or the same as adding $+nb$. But if we infer from this, that 1 is to $-n$ as $-b$ to nb, according to the rule, that unit is to one of the factors as the other factor is to the product, there is no ground to imagine that there is any mystery in this, or any other meaning than that the real magnitudes represented by 1, n, b, and nb are proportional. For that rule relates only to the magnitude of the factors and product, without determining whether any factor, or the product, is to be added or subtracted. But this must likewise be determined in algebraic computations; and such is the proper use of the rules concerning the signs, without which the operation could not proceed. Because a quantity to be subtracted is never produced in composition by any repeated addition of a positive, or repeated subtraction of a negative, a negative square number is never produced by composition from the root. Hence $\sqrt{-1}$, or the square root of a negative, implies an imaginary quantity; and, in resolution, it is a mark or character of the impossible cases of a problem, unless it is compensated by another imaginary symbol or supposition, when the whole expression may have a real signification. Thus $1+\sqrt{-1}$, and $1-\sqrt{-1}$, taken separately, are imaginary, but their sum is 2; as the conditions that would separately render the solution of a problem impossible, in some cases destroy each other's effect when conjoined. In the pursuit of general conclusions, and of simple forms representing them, expressions of this kind must sometimes arise where the imaginary symbol is compensated in a manner that is not always so obvious.

By proper substitutions, however, the expression may be transformed into another, in which each particular term may have a real signification as well as the whole expression. The theorems which are sometimes briefly discovered by the use of this symbol may be demonstrated without it by the inverse operation, or in some other way; and though such symbols are of some use in the computations by the method of fluxions, their evidence cannot be said to depend upon arts of this kind.

NEGINOTH. This term is found before some of the Psalms, as Psalm lxvii. It signifies *stringed instruments of music*, to be played on by the fingers, or female musicians; and the titles of those Psalms where this word is found may be thus translated: "A psalm of David to the master of music, who presides over the stringed instruments."

NEGOMBO, a large and populous village in the island of Ceylon, advantageously situated for carrying on the inland trade, particularly with Colombo, by a branch of the Mullivaddy River. It has a fort, erected by the Dutch, for the protection of the cinnamon cutters, which still remains; and there are, besides, three long ranges of buildings which serve for barracks and storehouses. The neighbouring county produces in abundance cinnamon and rice, and the gardens are well stocked with vegetables. This place was taken without opposition by the British in 1796. Long. 79. 49. E. Lat. 7. 19. N.

NEGRAIS Isle, a small island situated at the western mouth of the Irrawaddy River, in the kingdom of Ava. It has an excellent harbour, without exception the most secure in the Bay of Bengal, as a ship launches at once into the open sea, and may work to the southward without any other impediment except what the monsoon opposes. Cape Negrais, the south-westernmost extremity of India beyond

Negro.

the Ganges, is in long. 93. 15. E. and in lat. 16. N., and is known by a temple of Buddha erected on it. This island was occupied by the British in 1697, and it was supposed that it would entirely command the trade of Pegu, and form a secure harbour for the British ships during the monsoons. But these hopes proved fallacious, and the settlement was withdrawn. In the year 1757 the island was ceded to the British by Alompra, the Burman emperor, and the place was formally taken possession of in 1757. In 1759 some disputes having arisen between the Burman governor and the English resident, the place was suddenly attacked in the month of October, and all the British who could not effect their escape were suddenly put to death. Since this period the Burmans have been excessively jealous of any visits from Europeans, and will not permit any ships to pass up the Bassein branch of the river.

NEGRO, *homo pelle nigra*, a name applied to a variety of the human species, entirely black, and found in the torrid zone, especially in that part of Africa which lies within the tropics. In the complexion of negroes we meet with many various shades; but they likewise differ from other men in the features of their face. Round cheeks, high cheek-bones, a forehead somewhat elevated, a short, broad, flat nose, thick lips, small ears, ugliness, and irregularity of shape, characterize their external appearance.

The origin of the negroes, and the cause of their remarkable difference in colour from the rest of the human species, have much perplexed philosophical inquirers. Mr Boyle has observed, that it cannot be produced by the heat of the climate; for although the heat of the sun may darken the colour of the skin, yet experience does not show that it is sufficient to produce a new blackness like that of the negroes. In Africa itself, several nations of Ethiopia are not black; nor were there any blacks originally in the West Indies. In many parts of Asia under the same parallel with the African region inhabited by the blacks, the people are only tawny. Dr Barrière alleges that the gall of negroes is black, and, being mixed with their blood, is deposited between the skin and scarf-skin. Dr Mitchell of Virginia, in the Philosophical Transactions, has endeavoured, by many learned arguments, to prove that the influence of the sun in hot countries, and the manner of life of their inhabitants, are the remote causes of the colour of the negroes, Indians, and other races. Lord Kames, on the other hand, contends, along with many others, that no physical cause is sufficient to change the colour, and the regular features of white men, to the dark hue and the deformity of the negro. The arguments of these writers have been examined with much acuteness and ingenuity by Dr Stanhope Smith of New Jersey, Dr Hunter, and Professor Zimmerman, who have rendered it in a high degree probable that the action of the sun is the original and chief cause of the black colour, as well as of the distorted features, of the negro. In the article MAN the reader will find opinions stated which have been advanced in regard to the varieties of the human race.

The most serious charge brought against the poor negroes is, that of the *vices* which are said to be natural to them. If, indeed, they be such as their enemies represent them, treacherous, cruel, revengeful, and intemperate, by a necessity of nature, they must be of a different race from the whites; for although all these vices abound in Europe, it is evident that they proceed not from nature, but from bad education, which gives to the youthful mind such deep impressions as no future exertions can completely eradicate. Let us inquire coolly if the vices of the negroes may not have a similar origin.

In every part of Africa with which the nations of Europe have any commerce, slavery of the worst kind prevails. Three fourths of the people are slaves to the rest, and the children are born to no other inheritance. Most parts of the coasts differ in their governments; some are absolute monarchies, whilst others approach to an aristocracy. In both the authority of the chief or chiefs is unlimited, extending to life, and it is exercised as often as caprice dictates, unless death is commuted into slavery, in which case the offender is sold; but if the shipping will not buy the person condemned, he is immediately put to death. Fathers of free condition have power to sell their children, but this power is very seldom enforced. In Congo, however, a father will sell a son or daughter, or perhaps both, for a piece of cloth, a collar or girdle of coral or beads, and often for a bottle of wine or brandy. A husband may have as many wives as he pleases, and repudiate or even sell them, though with child, at his pleasure. The wives and concubines, though it be a capital crime for the former to break their conjugal faith, have a way of ridding themselves of their husbands, if they have set their affections upon a new gallant, by accusing them of some crime for which the punishment is death. In a word, the bulk of the people in every state of Africa are born slaves to great men, reared as such, held as property, and as property sold. There are indeed many circumstances by which a free man may become a slave, such as being in debt, and not able to pay; and in some of these cases, if the debt be large, not only the debtor, but his family likewise, become the slaves of his creditor, and may be sold. Adultery is commonly punished in the same manner, both the offending parties being sold, and the purchase-money paid to the injured husband. *Obi*, or pretended witchcraft, in which all the negroes firmly believe (see WITCHCRAFT), is another, and a very common offence, for which slavery is adjudged as a suitable punishment; and it extends to all the family of the offender. There are various other crimes which subject the offender and his children to be sold; and it is more than probable, that if there were no buyers, the poor wretches would be murdered without mercy.

In such a state of society, what dispositions can be looked for in the people, but cruelty, treachery, and revenge? Even in the civilized nations of Europe, blessed with the lights of law, science, and religion, some of the lower orders of the community consider it as a very trivial crime to defraud their superiors; whilst almost all look up to them with stupid malevolence or rancorous envy. That a depressed people, when they get power into their hands, become revengeful and cruel, the present age affords a dreadful proof in the conduct of the anarchists of a neighbouring nation; and is it wonderful that the negroes of Africa, unacquainted with moral principles, blinded by the cruelest and most absurd superstitions, and whose customs tend to eradicate from the mind all natural affection, should sometimes display to their lordly masters of European extraction the same spirit which was so generally displayed by the lower orders of Frenchmen towards their ecclesiastics, their nobles, and the family of their murdered sovereign? When we consider that the majority of the negroes groan under the most cruel slavery, both in their own country, and in every other where they are to be found in considerable numbers, it cannot excite surprise that they are in general treacherous, cruel, and vindictive. Such are the caprices of their tyrants at home, that they could not preserve their own lives or the lives of their families for any length of time, except by a perpetual vigilance, which must necessarily degenerate, first into cunning, and afterwards into treachery; and it is not conceivable that habits formed in Africa should be instantly thrown off in the West Indies, where they become the property of men whom some of them must consider as a different race of beings.

But the truth is, that the bad qualities of the negroes have been greatly exaggerated. Mr Edwards, in his valuable History of the West Indies, assures us that the Mandingo negroes display such gentleness of disposition and demeanour, as would seem the result of early education and discipline, were it not that, generally speaking, they are more prone to theft than any of the African tribes. It has been supposed that this propensity, amongst other vices, is natural to a state of slavery, which degrades and corrupts the human mind in a deplorable manner; but why the Mandingos should have become more vicious in this respect than the rest of the natives of Africa in the same condition of life, is a question he cannot answer.

"The circumstances which," according to the same author, "distinguish the Koromantyn or Gold Coast negroes from all others, are firmness both of body and mind; a ferociousness of disposition; but withal, activity, courage, and a stubbornness, or what an ancient Roman would have deemed an elevation of soul, which prompts them to enterprises of difficulty and danger, and enables them to meet death, in its most horrid shape, with fortitude or indifference. They sometimes take to labour with great promptitude and alacrity, and have constitutions well adapted for it; for many of them have undoubtedly been slaves in Africa. But as the Gold Coast is inhabited by various tribes, which are engaged in perpetual warfare and hostility with each other, there cannot be a doubt that many of the captives taken in battle, and sold in the European settlements, were of free condition in their native country, and perhaps the owners of slaves themselves. It is not wonderful that such men should endeavour, even by means the most desperate, to regain the freedom of which they have been deprived; nor do I conceive that any further circumstances are necessary to prompt them to action, than that of being sold into captivity in a distant country. One cannot surely but lament," says our author, "that a people thus naturally intrepid, should be sunk into so deplorable a state of barbarity and superstition; and that their spirits should ever be broken down by the yoke of slavery. Whatever may be alleged concerning their ferociousness and implacability in their present notions of right and wrong, I am persuaded that they possess qualities which are capable of, and well deserve, cultivation and improvement.

"Very different from the Koromantyns are the negroes imported from the Bight of Benin, and known in the West Indies by the name of Eboes. So great is their constitutional timidity and despondency of mind, as to occasion them very frequently to seek, in a voluntary death, a refuge from their own melancholy reflections. They require, therefore, the gentlest and mildest treatment to reconcile them to their situation; but if their confidence be once obtained, they manifest as great fidelity, affection, and gratitude, as can reasonably be expected from men in a state of slavery. The females of this nation are better labourers than the men, probably from having been more hardly treated in Africa.

"The natives of Whidah, who in the West Indies are generally called *Papaws*, are unquestionably the most docile and best disposed slaves that are imported from any part of Africa. Without the fierce and savage manners of the Koromantyn negroes, they are also happily exempt from the timid and desponding temper of the Eboes. The cheerful acquiescence with which these people apply to the labours of the field, and their constitutional aptitude for such employment, arise, without doubt, from the great attention paid to agriculture in their native country. Bosman speaks with rapture of the improved state of the soil, the number of villages, and the industry, riches, and obliging manners of the natives. He observes, however, that they are much greater thieves than those of the Gold Coast, and very unlike them in another respect, namely, in the dread of pain, and the apprehension of death. They are, says he, so very apprehensive of death, that they are unwilling to hear it mentioned, for fear that alone should hasten their end; and no man dares to speak of death in the presence of the king, or any great man, under the penalty of suffering it himself, as a punishment for his presumption. He relates further, that they are addicted to gaming beyond any people of Africa. All these propensitics are observable in the character of the Papaws in a state of slavery in the West Indies. That punishment which excites the Koromantyn to rebel, and drives the Ebo negro to suicide, is received by the Papaws as the chastisement of legal authority, to which it is their duty to submit patiently. The case seems to be, that the generality of these people are in a state of absolute slavery in Africa, and, having been habituated to a life of labour, they submit to a change of situation with little reluctance."

In a word, as the colour, and features, and moral qualities of the negroes may be accounted for by the influence of climate and the modes of savage life, so there is good reason to believe that their intellectual endowments may likewise be referred to circumstances, and that they are equal to those of the whites who have been found in the same hapless situation.

NEGROLAND. See NIGRITIA.

NEGROPONT, an island in the Mediterranean, the ancient Eubœa, extending in north latitude from 37. 56. to 39. 8., and in east longitude from 22. 41. to 24. 33. It is connected with the mainland by a very long bridge, and is a mountainous country, inhabited by sixty thousand persons, two thirds of whom are Greeks. The capital is a city of the same name, being the ancient Chalcis, and is estimated to contain sixteen thousand inhabitants, most of whom are Turks. It is situated in long. 23. 34. E. and lat. 38. 31. N.

NEGRO, RIO, a large river of Patagonia, in South America. The banks of this river, as well as the numerous islands with which it is in many parts studded, are covered with low willows, from which cause it is sometimes called the Rio Sauces. Its Indian name is Cusu-Leubu, signifying Rio Negro, or the Black River, from the dark hue of its waters.[1] The results of the expedition alluded to in the note were important, although not so completely satisfactory as could have been wished, as the large affluent from the north, supposed to be Diamante, was not examined. But the great point established was, that it is possible to navigate the main stream of the Rio Negro from its mouth, in the Southern Atlantic, to the very foot of the Cordillera of Chili, within fifty miles of Valdivia, upon the shores of the Pacific, a distance of about 525 miles without including the windings of the river. From its mouth in south latitude 41° 5′, to the great island of Choleechel or Chuelechel, in latitude 39°, its general course tends to the north-north-west, although in some parts it is exceedingly tortuous. As far as this point, the bottom of the river is sand, and the country is described as an arid sandy level, destitute of vegetation, excepting some insulated patches along the shore, which being from time to time flooded, are covered with good pasturage. The island of Choleechel, which constitutes so conspicuous a feature in the map of the river, is twenty-seven miles in length

[1] This river, which forms so important a feature in the geography of that part of South America, has hitherto been laid down solely on the authority of Father Falkner's work upon Patagonia, published in this country in the year 1775. In the year 1836, however, the Royal Geographical Society of London published a correct account and map of it, which were derived from a Journal of an Original Voyage of Discovery up the Rio Negro, performed in the years 1782–1783, by Don Basilio Villarino, who had been employed for the purpose by the Spanish government. To these we have had recourse in drawing up the above article.

and nine in width; but appears to produce nothing except pasturage. From this island to Diamante, a distance of 156 miles, the course of the river is nearly due west; its bottom is gravelly, with many pebbles, and the aspect of the country is for the most part desolate from want of vegetation. The Diamante, at its confluence with the Rio Negro, is nearly as large as the latter river; and as it appears to be the drainage of numerous streams which descend from the eastern side of the Cordillera, between the latitudes of 32° and 36°, its periodical floods must be formidable, and much greater than those of the Rio Negro. It is much intersected by small islands overgrown with stunted willows. The low lands along the shore are sterile, and all beyond a range of steep red cliffs, by which these are bounded, the country appeared totally destitute of herbage, not a tree being visible. From about the confluence of these two rivers, the Rio Negro takes a south-south-western direction, running between high precipitous banks, where in some parts the river was not more than five hundred yards across. After these are passed, the country becomes more level, and the stream widens. Another considerable tributary, called the Pichi Epicuntu, which descends from some of the snowy peaks of the Cordillera, flows into the Negro in lat. 39° 35′ S. Farther onwards the river becomes intersected by innumerable islands, extremely shallow in some parts; and the bottom is strewed with rounded stones and boulders, which increase in size as the range of the Cordillera is approached. The windings of the river also become very large, and, from flowing in a main current nearly due south, it takes a westerly direction, and then bends to the north. The farthest point reached by Villarino was in lat. 39° 40′; and here, within fifty miles of Valdivia, his course was checked by the Indians, who appear to have been apprehensive that his expedition had for its main object the stoppage of a great pass near Choleechel, by which they were in the habit of making predatory excursions into the province of Buenos Ayres. He, in fact, points out how these marauders might be effectually kept in check by establishing a fort at the point above mentioned; and, after a lapse of fifty years, this suggestion has been carried into effect by the authorities of Buenos Ayres. In 1833 a military post was formed at the Choleechel, which will not only secure the southern parts of the republic from the hostile inroads of the Indians, but will no doubt ultimately lead to our obtaining much new and interesting information respecting a vast tract of country as yet unknown to us. The depth of the Rio Negro varies much, as well as the current, depending in some measure on the breadth of the bed of the river; and it is liable to great changes in the time of the floods, which are periodical, and twice in the year, from the rains in the winter, and the melting of the snows in summer. With regard to its breadth, nothing satisfactory can be stated, as it varies exceedingly at all times, and widens and contracts at different seasons of the year.

NEGROS, one of the Philippine Islands, in the Eastern Seas, situated due north of Luzon or Laconia, about the 123d degree of east longitude. It is about 145 miles in length by twenty-five in average breadth, and is fruitful in rice, for which the inhabitants pay tribute. The island was so named by the Spaniards, from the Papuan or oriental negroes, its original inhabitants, who still inhabit the mountains, being in a state of savage independence, and continually at war with each other. Long. 122. 30. E. Lat. 10. 10. N.

NEHAVEND, or NEHANUD, a town of Persia, in the province of Irak, sixty miles south of Hamadan. It is celebrated for a battle fought there between the Saracens and Persians in the year 638, when the Sassanian dynasty was overthrown, and the Saracens established themselves on the throne of Persia.

NEHEMIAH, or NEHEMIAS, son of Hachaliah, was born at Babylon during the captivity (Nehem. i. 1, 2, *et seq.*). He was, according to some, of the race of the priests; but according to others, he was of the tribe of Judah and the royal family. Those who maintain the former opinion support it by a passage in Ezra (x. 10), where he is called a priest; but those who believe that he was of the race of the kings of Judah say that as Nehemiah for a considerable time governed the republic of the Jews, it is probable he was of that tribe to which the kings always belonged. Nehemiah mentions his brethren Hanani, and some other Jews, who, having come to Babylon during the captivity, acquainted him with the sad condition of their country; and the office of cup-bearer to the king of Persia, to which Nehemiah was promoted, is considered as a further proof that he was of an illustrious family. Lastly, he excuses himself from entering into the inner part of the temple, probably because he was only a layman (Nehem. vi. 11). "Should such a man as I flee? And who is there that, being as I am, would go into the temple to save his life?" The Scripture (Ezra, ii. 63; Nehem. vii. 65) calls him *tirshatha*, or cup-bearer; no doubt because he held this employment at the court of Artaxerxes Longimanus. He had an exceeding great tenderness for the country of his fathers, although he had never seen it; and one day, when some Jews newly arrived from Jerusalem acquainted him with the miserable state of that city, that its walls were beaten down, its gates burned, and the Jews become a reproach amongst all nations, he became so sensibly affected with this relation, that he fasted, prayed, and humbled himself before the Lord, imploring him to be favourable to the design which he had then conceived of asking the king's permission to rebuild Jerusalem. In the course of his attendance at court, he presented the cup to the king according to custom, but with a countenance sad and dejected, which the king observing, entertained some suspicion that he had conceived some evil design; but Nehemiah disclosing the occasion of his disquiet, explained the cause of his grief, upon which Artaxerxes gave him permission to go to Jerusalem, and repair its walls and gates, upon this condition, however, that he should return to court at a time appointed. Letters were accordingly made out, directed to the governors beyond the Euphrates, with orders to furnish Nehemiah with the timbers necessary for covering the towers and gates of the city, and the house designed for Nehemiah himself, who was now appointed governor of Judæa, in the year of the world 3350.

Nehemiah having arrived at Jerusalem with the king's commission, went round the city, and having viewed the condition of the walls, assembled the chief of the people, produced his commission, and exhorted them to undertake the reparation of the gates and the walls of the city. Finding every person ready to obey him, he immediately began the work. The enemies of the Jews observing these works in such forwardness, employed all the means in their power to deter Nehemiah from this undertaking, and made several attempts to surprise him; but finding that their designs had been discovered, and that the Jews were upon their guard, they had recourse to stratagem, endeavouring to draw him into an ambuscade in the fields, where they pretended they would finish the dispute at an amicable conference. But Nehemiah gave them to understand that the work he had begun required his personal attendance, and that therefore he could not meet them. He returned the same answer to four several messages that they sent, one after another, on the same subject.

Sanballat, the chief of the enemies of the Jews, together with his associates, sent information of a report that the Jews were building the walls of Jerusalem solely with the design of rendering it a place of strength, to support them in an intended revolt; and that Nehemiah had also suborned

Neidersel-ters.

false prophets to favour his designs, and to encourage the people to choose him king; wherefore, in order to put a stop to these rumours, he advised Nehemiah to come to him, that they might confer together, and adopt such resolutions as should be found convenient. Nehemiah, however, gave himself no trouble on this account, but returned for answer, that all these accusations were false, and had been made at random. About the same time he discovered that a false prophet called Shemaiah had been corrupted by his enemies, and that some of the chief men of the city were secretly in confederacy with them. Yet all this did not discourage him; he went on with his work, and happily completed it in fifty-two days after it had been commenced.

We read in the books of the Maccabees that Nehemiah sent to search for the holy fire, which before the captivity of Babylon the priests had hidden in a dry and deep pit; but not finding any fire there, and only a thick muddy water, he sprinkled this upon the altar; whereupon the wood which had been moistened with this water took fire as soon as the sun began to appear. When this miracle came to the knowledge of the king of Persia, he caused the place to be encompassed with walls where the fire had been hidden, and granted great favours and privileges to the priests. It is recorded in the same books, that Nehemiah erected a library, in which he placed whatever he could find, either of the books of the prophets, of King David, or of such princes as had made presents to the temple. Lastly, he returned to Babylon, according to the promise which he had made to king Artaxerxes, about the thirty-second year of that prince's reign, and in the year of the world 3563; but he subsequently revisited Jerusalem, where he died in peace, about the year 3580, having governed the people of Judah for about thirty years.

The book which, in the English Bible, as well as in the Hebrew, bears the name of *Nehemiah*, is in the Latin Bible called the book of *Esdras;* and it must be confessed, that though this author speaks in the first person, and though at the first reading one would think that he had written it day by day as the transactions occurred, yet there are some things in the book which could not have been written by Nehemiah himself. For example, memorials are quoted, in which were registered the names of the priests in the time of Jonathan the son of Eliashib, and even down to the times of the high priest Jaddus, who went out to meet Alexander the Great, which must have been afterwards added.

It may well be questioned whether this Nehemiah be the same that is mentioned in Ezra, ii. 2, and Nehem. vii. 7, as one who returned from the Babylonian captivity under Zerubbabel; since from the first year of Cyrus to the twentieth of Artaxerxes Longimanus, no less than ninety-two years intervene; so that Nehemiah must at this time have been a very old man, at the lowest computation an hundred, and consequently incapable of being the king's cup-bearer, of taking a journey from Shushan to Jerusalem, and of behaving there with all the courage and activity which have been ascribed to him. We may therefore conclude that this was a different person, though of the same name, and that Tirshatha, the other name by which he is called (Ezra, ii. 63; and Nehem. vii. 65), denotes the title of his office, and, both in the Persian and Chaldaic tongues, was the general name given to the king's deputies and governors.

NEIDERSELTERS, a town of the bailiwick of Idstein, in the duchy of Nassau, in Germany, celebrated for the mineral spring which yields the water known through Europe by the name of Seltzer water. Besides what is used on the spot, more than two millions and a half of jugs of it are despatched to different countries, and produce a clear revenue of L.5000. The town is situated in a picturesque country, and contains about 900 resident inhabitants, but receives a great deal of company during the summer season.

Neisse || Nelson.

NEISSE, a city, the capital of a district of the same name, in Prussian Silesia. It stands at the junction of the river Biele with the Neisse, in a marshy situation, though at the height of 580 feet above the level of the sea. It is strongly fortified, especially with effective ditches, and contains an Episcopal palace, seven Catholic and two Lutheran churches. There is a Catholic college, with about 300 students, besides a large endowed grammar school. It contains 9440 inhabitants, amongst whom are extensive manufacturers of linen goods; besides which, hosiery, hats, brandy, and other articles, are manufactured. Long. 17. 14. E. Lat. 51. 25. N.

NEITRA, a circle of the province of the Lower Danube, in the Austrian kingdom of Hungary. It extends over 2662 square miles, and contains a population of 348,500 persons, chiefly of the Sclavonian race; and it comprises two cities, thirty-eight market towns, and 462 villages and hamlets. The capital is a city of the same name, the seat of a bishop, containing 500 houses and 3958 inhabitants, whose chief trade is in wine. Long. 17. 58. 56. E. Lat. 48. 19. 10. N.

NEJIN, a city of Russia, in the province of Tchernigow, in what was formerly distinguished as Little Russia. It stands on the river Oster. The streets are intermixed with large gardens, filled with fruit trees of various kinds. It contains 1000 houses, two convents, and sixteen churches, all built after the model of those in Moscow, and is reckoned the handsomest town to the south of that capital. The inhabitants are about 12,000, composed, besides Russians and Kossacks, of many Greek and Armenian families. The most distinguished building is the Gymnasium Bezborodko, founded by the count of that name. It is a large edifice, adorned by a colonnade of twelve Ionic pillars, and, being surrounded by high trees, it has a truly noble appearance. It was instituted for the education of young noblemen.

NELSON, Horatio, Lord Viscount, the greatest naval commander that any age or country has produced, was the son of Edmund and Catherine Nelson, and was born on the 29th of September 1758, at the parsonage house of Burnham-Thorpe, a village in the county of Norfolk, of which his father was rector. The maiden name of his mother was Suckling; her grandmother was an elder sister of Sir Robert Walpole, and the subject of this notice was named after the first Earl of Orford. Mrs Nelson died in 1767, leaving eight out of eleven children. Upon this occasion her brother, Captain Maurice Suckling, of the navy, visited Mr Nelson, and promised to take care of one of the boys. Three years afterwards, when Horatio was only twelve years of age, being at home during the Christmas holidays, he read in the county newspaper that his uncle had been appointed to the Raisonnable of sixty-four guns, and immediately applied to his father for permission to go to sea with his uncle. The boy was then receiving his education at North Walsham; and his constitution, which was naturally weak, had been much impaired by an attack of the ague, at that time one of the most common diseases in England. But his father's circumstances were straitened, and he had no prospect of seeing them bettered; he knew that it was the wish of providing for himself by which Horatio was chiefly actuated; he also understood the boy's character, and conceived that, in whatever station he might be placed, he would, if possible, climb to the top of the tree. The uncle was accordingly written to, and gave a reluctant consent to the proposal which had been made to him. "What," said he, in reply, "has poor Horatio done, who is so weak, that he should be sent to rough it out at sea? But let him come, and the first time we go into action a cannon-ball may knock off his head, and provide for him at once." The Raisonnable, on board of which he was now placed as a midshipman, had been commissioned on account of the dispute respecting the Falkland Islands; but as soon as the difference with the court of Spain had been accommodated, the ship was paid off, and Captain Suckling removed to the Triumph of seventy-four guns, then stationed as a guard-ship in the Thames. This, however, was considered as too inactive a life for a boy, and Nelson was therefore sent a voyage to the West Indies in a merchant ship, commanded by a person who had served as master's mate under his uncle in the Dreadnought. He returned a practical seaman, but with no affection for the king's service, and was received by his uncle on board the Triumph, then lying at Chatham, in the month of July 1772.

Not many months after his return, his inherent love of enterprise was excited by hearing that two ships were fitting out for a voyage of discovery towards the North Pole. From the difficulties expected on such service, these vessels were to take out none but effective men, instead of the usual number of boys. This, however, did not deter Nelson from soliciting to be received, and by his uncle's interest he was admitted as cockswain under Captain Lutwidge, the second in command. The voyage was undertaken in consequence of an application from the Royal Society; and the Honourable Captain John C. Phipps, eldest son of Lord Mulgrave, volunteered his services to command the expedition. The Racehorse and Carcass, bombs, were selected as the strongest ships, and therefore best adapted for such a voyage; and they were taken into dock and further strengthened, to render them as secure as possible against the ice. Two masters of Greenlandmen were employed as pilots for each ship; and the first lord of the admiralty, Lord Sandwich, with a laudable solicitude, took care to see that every thing had been provided to the wish of the officers. The expedition sailed from the Nore on the 4th of June 1773, and in the course of the following month came in sight of Spitzbergen, whence they proceeded to Moffen Island, beyond which they discovered seven other islands situated in the latitude of 81. 21. north. But advancing further in search of an opening, the ships were beset with ice, in which they became suddenly wedged, no fissure of any kind being visible; and in this critical situation they remained five days, during which they were exposed to the greatest danger, and would inevitably have been destroyed if the ice had been agitated by the slightest breeze. Fortunately the weather remained singularly calm, and the ice having itself begun to drift to the westward, the ships were at length got clear. The season was now so far advanced that nothing more could have been attempted, if indeed any thing had been left untried. But the summer had been unusually favourable; and they had carefully surveyed the vast wall of ice extending for more than twenty degrees between the latitudes of 80° and 81° without discovering the smallest appearance of an opening. The expedition returned to England in October, and shortly afterwards the ships were paid off.

During this voyage Nelson gave several indications of that daring and fearless spirit which ever afterwards distinguished him. Having been appointed to command one of the boats sent out to explore a passage into the open water, he was instrumental in saving a boat belonging to the Racehorse from a singular but imminent danger. Some of the officers having fired at and struck a walrus, the wounded animal immediately dived, and having brought up a number of its companions, they all joined in an attack upon the boat. They wrested an oar from one of the men, and it was with the utmost difficulty that the crew could prevent them from staving or upsetting the boat, till that of the Carcass came up to their assistance, upon which the walruses, finding their enemies thus reinforced, dispersed. Young Nelson exposed himself in a yet more daring manner. One night, during the middle watch, he stole unperceived from the ship with one of his comrades, and taking advantage of a rising fog, set out in pursuit of a bear. It was not long before he was missed. The fog thickened, and Captain Lutwidge and his officers became exceedingly alarmed for their safety. Between three and four in the morning the fog cleared away, when the two adventurers were seen, at a considerable distance from the ship, attacking a huge bear, which they were only enabled to keep at bay by a chasm in the ice. Captain Lutwidge, seeing their danger, fired a gun, which had the desired effect of frightening the beast; and, on their return to the ship, he sternly reprimanded young Nelson for conduct so unworthy of the office he filled. When asked what motive he could have had for leaving the ship to hunt a bear, he replied, "I wished to kill it, that I might carry the skin to my father."

The ships were paid off shortly after their return, and the youth was then placed by his uncle with Captain Farmer in the Seahorse of twenty guns, which was about to sail for the East Indies in the squadron of Sir Edward Hughes. In this ship he was rated as a midshipman, and attracted attention by his general good conduct. But when he had been about eighteen months in India, he felt the effects of the climate of that country, so perilous to European constitutions, and became so enfeebled by disease that he lost for a time the use of his limbs, and was brought almost to the brink of the grave. He embarked for England in the Dolphin, Captain Pigot, with a body broken down by sickness, and spirits which had sunk with his strength. But his health materially improved during the voyage, and his native air speedily repaired the injury it had sustained. On the 8th of April 1777 he passed, with much credit to himself, his examination for a lieutenancy, and next day received his commission as second lieutenant of the Lowestoffe, of thirty-two guns, then fitting out for Jamaica. In this frigate he cruised against the American and French privateers which were at that time harassing our trade in the West Indies; distinguished himself on various occasions by his activity and enterprise; and formed a friendship with his captain, Locker, of the Lowestoffe, which continued during his life. Having been warmly recommended to Sir Peter Parker, the commander-in-chief upon that station, he was removed into the Bristol flag-ship, and soon afterwards became first lieutenant. On the 8th of December 1788, he was appointed commander of the Badger brig, in which he rendered important assistance in rescuing the crew of the Glasgow, when that ship was accidentally set on fire in Montego Bay, Jamaica.

In the course of the following year (11th of June 1799), he obtained the rank of post-captain, and with it the command of the Hinchinbrook of twenty-eight guns, an enemy's merchantman, sheathed with wood, which had been taken into the service. As Count d'Estaing, with a fleet of 125 sail, men of war and transports, and a reputed force of 25,000 men, now threatened Jamaica from St Domingo, Nelson offered his services to the admiral and the governor-general, Dalling, and was appointed to command the batteries of Fort-Charles at Port-Royal, the most important post in the island. D'Estaing, however, attempted nothing with this formidable armament, and the British general was thus left to execute a design which he had formed against the Spanish colonies. This project was to take Fort San Juan, situated upon the river of that name, which flows from Lake Nicaragua into the Gulf of Mexico; to make himself master of the lake itself, and of the cities of Granada and Leon; and thus to cut off the communication between the northern and southern possessions of Spain in America. Nelson was appointed to the command of the naval department, and that of the military was committed to a major in the army. But although the gene-

Nelson. ral's plans were well formed, the nature of the country had not been studied so accurately as its geography. The difficulties which occurred in fitting out the expedition delayed it till the season was too far advanced; and the men were thus sent to adventure themselves, not so much against an enemy whom they might have beaten, as against a climate which would effectually do the enemy's work. Early in 1780, five hundred men, destined for this service, were convoyed by Nelson from Port-Royal to Cape Gracias a Dios in Honduras; and, on the 24th of March, they reached the river San Juan, where Nelson's services were to terminate. But not a man in the expedition had ever been up the river, or knew the distance of any fortification from its mouth. Nelson, however, not being one to turn his back when so much was to be done, resolved to carry up the soldiers, and, in spite of every difficulty, succeeded in conveying them a hundred miles up a river which none but Spaniards had navigated since the time of the buccaneers. On the 9th of April they reached a small island, called St Bartolomeo, which the Spaniards had fortified as an outpost, to command the river, in a rapid and difficult part of the navigation. Nelson, at the head of a few seamen, leaped upon the beach, and being gallantly supported by Despard, then a captain in the army, advanced against the battery, which he at once stormed, or, in his own phrase, boarded, driving away the Spaniards, and capturing their guns. The castle of San Juan, situated sixteen miles higher up, was the next object of attack. Nelson advised that it should instantly be carried by assault; but he was not the commander, and it was thought proper to observe the formalities of a siege. The attack commenced on the 13th, and the place surrendered on the 24th of April. But victory procured to the conquerors none of that relief which they had expected. No supplies of any kind were found; the castle itself proved worse than a prison; the huts which served as hospitals were surrounded with filth and putrid hides; sickness at length became general, leaving few men able to perform garrison duty; and the rains continued with scarcely any interval from April till October, when this baleful conquest was abandoned. Of 1800 men who had been sent to different posts upon this wretched expedition, not more than 380 ever returned. Nelson himself was saved by a timely removal, though not until after he had been seized with the prevailing dysentery. Having been appointed to succeed Captain Glover in the Janus of forty-four guns, he sailed for Jamaica; but on reaching Port-Royal he found himself so greatly reduced by the disorder, that he was compelled to ask leave to return to England, as the only means of recovery. He was taken home in the Lyon, by Captain, afterwards Admiral, Cornwallis, to whose care and kindness he believed himself indebted for the preservation of his life.

In three months, however, his health was so far re-established that he applied for employment; and being appointed to the Albemarle of twenty-eight guns, he was sent to the North Seas, and kept there during the whole winter, a mode of conduct which he deeply resented, as equally cruel to the individual, and detrimental to the service. In this cruize, however, he gained a considerable knowledge of the Danish coast and its soundings. On his return he was ordered to Quebec, and in consequence sailed for Canada. During this cruise, the Albemarle had a narrow escape from four French sail of the line and a frigate, which having come out of Boston, gave chase to her. Confiding in his own skill in pilotage, Nelson, perceiving that they gained on him, boldly ran amongst the numerous shoals of St George's bank, and thus escaped. In October 1782, he sailed from Quebec with a convoy of transports for New York, where he joined Lord Hood, who, with a detachment of Rodney's victorious fleet, was then at Sandy Hook. His professional merit was already so well known, that Lord Hood, on introducing him to the Duke of Clarence, who was at that time serving as a midshipman in the Barfleur, told his royal highness that, if he wished to ask any questions in naval tactics, Captain Nelson could give him as much information as any officer in the fleet. In November he accompanied Lord Hood to the West Indies, and continued there in active employment till the peace of 1783, when the Albemarle returned to England, and was paid off. Nelson.

After his arrival in England, Nelson, finding it prudent to economise his half-pay during the peace, went to France, and took lodgings at St Omers, where he remained till the spring of the following year. In the interval he had lost his favourite sister, and formed an attachment for the daughter of an English clergyman, whom his straitened circumstances alone prevented him from marrying. On his return he was appointed to the Boreas of twenty-eight guns, which had been ordered to the Leeward Islands as a cruiser on the peace establishment. Whilst on this station, where he found himself senior captain, and consequently second in command, he evinced the utmost zeal and activity in protecting British interests, and in causing the navigation act to be respected, especially by the Americans, who had attempted, under various pretences, to establish an independent commerce with the West India Islands; a line of conduct which involved him in much trouble, without procuring him reward or even acknowledgment, the thanks of the treasury having been transmitted to the commander-in-chief, who had thwarted instead of encouraging him in the discharge of an arduous and important duty. He had, however, something to console him amidst his perplexities. Having become acquainted with an amiable and accomplished lady, the widow of Dr Nisbet, a physician, and then only in her eighteenth year, he made proposals of marriage, which were accepted, and they were married on the 11th of March 1787, the Duke of Clarence, who had gone out to the West Indies the preceding winter, being present, by his own desire, to give away the bride. During his service upon this station he had ample opportunities of observing the scandalous practices of the contractors, prize-agents, and other persons in the West Indies connected with the naval service, and he did every thing in his power to check them, although, unhappily, without success. The Boreas returned to England in June, but was not paid off till the end of November, having been kept nearly five months at the Nore as a slop and receiving ship. Nelson was still in a very precarious state of health; and this unworthy treatment, whether it proceeded from intention or neglect, excited in his mind the strongest indignation. His resentment, however, was appeased by the favourable reception which he met with at court, when presented to his majesty by Lord Howe; and having fully explained to that nobleman the grounds upon which he had acted, he retired to enjoy the pleasures of domestic happiness at the parsonage-house at Burnham-Thorpe, which his father had given him as a residence. But the vexatious affair of the American captures was not yet terminated. He was harassed with threats of prosecution, and, in his absence on some business, a writ or notification was served on his wife, upon the part of the American captains, who now laid their damages at L.20,000. When presented with this paper, his indignation was excessive; and he immediately wrote to the treasury, that unless he was supported by government he would leave the country. "If sixpence would save me from prosecution," said he, "I would not give it." The answer he received, however, quieted his fears; he was told to be under no apprehension, for he would assuredly be supported; and here his disquietude upon this subject seems to have ended.

During the time which he spent in retirement, he repeatedly requested the admiralty not to leave him to rust in indolence; but his various applications were unsuccessful. At the commencement of the French war, however, it was judged expedient to employ him; and, on the 30th of January 1793, he was appointed to the Agamemnon of sixty-four guns, and placed under the orders of Lord Hood, then appointed to the chief command in the Mediterranean. The limits prescribed to this article admit not of our entering into any details of his various achievements upon this station. The high opinion which Lord Hood entertained of his talents and ability, as well as courage, was manifested by the arduous services with the execution of which his lordship intrusted him. Being sent to Corsica with a small squadron to co-operate with Paoli and the party opposed to France, he undertook the siege of Bastia, and in a short time reduced it. The place capitulated on the 19th of May 1794. He next proceeded in the Agamemnon to co-operate with General Sir Charles Stuart in the siege of Calvi. Here Nelson had less responsibility than at Bastia; he was acting with a man after his own heart, who slept every night in the advanced battery. But the service proved not less hard than that of the former siege; twenty-five pieces of heavy ordnance having been dragged to the different batteries, mounted, and, all but three, fought by seamen. Here Nelson received a serious injury. A shot having struck the ground near him, drove the sand and small gravel into one of his eyes. He spoke of it lightly at the time, and in fact suffered it to confine him only one day; but the sight of the eye was nevertheless lost. After the fall of Calvi his services were, by a strange omission, altogether overlooked, and his name was not even mentioned in the list of wounded. Nelson felt himself not only neglected, but wronged. "They have not done me justice," said he; "but never mind, I'll have a gazette of my own." And, on another occasion, the same second-sight of glory led him to predict that one day or other he would have a long gazette to himself. "I feel," said he, "that such an opportunity will be given me. If I am in the field of glory, I cannot be kept out of sight."

Lord Hood now returned to England, and the command devolved upon Admiral Hotham. At this time the affairs of the Mediterranean wore a gloomy aspect. Tuscany had concluded peace with France; Corsica was in danger; Genoa was threatened; and the French, who had not yet been taught to feel their inferiority upon the seas, openly braved us on that element. Having a superior fleet in the Mediterranean, they now sent it out with express orders to seek the English and engage them. In the action which followed between the English fleet under Admiral Hotham, and that which had come out from Toulon, Nelson greatly distinguished himself, manœuvring and fighting his ship with equal ability and determination; and when the action was renewed the following day, he had the honour of hoisting the English colours on board of the Ça Ira and the Censeur, which both struck to him, and were the only ships of the enemy taken on that occasion.[1] About this time Nelson was made colonel of marines, a mark of approbation which he had rather wished for than expected; and soon afterwards the Agamemnon was ordered to Genoa to co-operate with the Austrian and Sardinian forces. This was indeed a new line of service, imposing multifarious duties, and involving great responsibility; yet it was also one for which Nelson had already evinced a singular aptitude, and in which, had he been at all seconded by the land forces, his assistance would have led to important results. But there was no unity in the views of the allied powers, no cordiality in their co-operation, no energy in their councils. They acted upon no fixed principle, and their officers were distinguished only for their utter incapacity. Through the gross misconduct of the Austrian general, Devins, the allies were completely defeated by an army of boys, and the French obtained possession of the Genoese coast from Savona to Voltri, thus intercepting the direct communication between the Austrian army and the English fleet. After this disgraceful affair, the Agamemnon was recalled, and sailed for Leghorn to refit, being literally riddled with shot, and having all her masts and yards wounded.

Sir John Jervis having arrived to take the command in the Mediterranean, Nelson sailed from Leghorn in the Agamemnon, which had now been repaired, and joined the admiral in Fiorenzo Bay. When the French took possession of Leghorn, he blockaded that port, and landed a force in the isle of Elba to secure Porto Ferrajo. Soon afterwards he took the island of Capraja; and the British cabinet having resolved to evacuate Corsica, he ably performed this humiliating service. He was then ordered to hoist his broad pendant on board of the Minerve frigate, Captain George Cockburn, and to proceed, with the Blanche, to Porto Ferrajo, and bring away the troops and stores left at that place. On his way thither he fell in with two Spanish frigates, the Sabina and Ceres, the former of which, after an action of three hours, during which the Spaniards lost 164 men, struck to the Minerve. The Ceres, however, had got off from the Blanche; and as the prisoners had hardly been conveyed on board of the Minerve when another enemy's frigate came up, Nelson was compelled to cast off the prize and go a second time into action. But after a short trial of strength, this new antagonist wore and hauled off; and as a Spanish squadron of two sail of the line and two frigates now came in sight, the commodore made all sail for Porto Ferrajo, whence he soon returned with a convoy to Gibraltar.

Having completed this service, he immediately proceeded to the westward in quest of the admiral, being apprehensive lest a general action should take place before he could join the fleet. Off the mouth of the Straits he fell in with the Spanish fleet, and, reaching the station off Cape St Vincent on the 13th of February 1797, he communicated this intelligence to Sir John Jervis, by whom he was now directed to shift his broad pendant on board the Captain, of seventy-four guns. Before sunset the signal was made to prepare for action, and to keep in close order during the night; and at day-break on the 14th the enemy were in sight. The British force consisted of two ships of 100 guns, two of 98, two of 90, eight of 74, and one of 64, with four frigates, a sloop, and a cutter; the Spaniards had one ship of 136 guns, six of 112 guns each, two of 84, and eighteen of 74, with ten frigates and a brig. The disproportion was no doubt great, but it was in a great measure neutralised by the superiority of the British crews, and the tactical ability displayed by the British admiral. Before the enemy could form a regular order of battle, Sir John Jervis, by carrying a press of sail, came up with them, passed through their fleet, then tacked, and thus cut off nine of their ships from the main body. These ships now attempted to form on the larboard tack, either with a design of passing through the British line, or of running to leeward of it, and thus rejoining their friends. But only one of them succeeded, because, being covered with smoke, her intention was not discovered till she had reached the rear; the others were so warmly received that they put about, took to flight, and did not appear again in the action till

[1] Nelson urged the admiral to pursue the enemy, and follow up his advantage to the utmost; but the latter replied, "We must be contented; we have done very well." The captain of the Agamemnon did not understand such timid reasoning. "Had we taken ten sail," said he, "and allowed the eleventh to escape when it had been possible to have got at her, I could never have called it well done." He adds, that, if his advice had been followed, they would have had such a day as the annals of England never produced.

Nelson. its close. The admiral being now at liberty to direct his attention to the enemy's main body, still superior in number to his whole fleet, made signal to tack in succession. Nelson, whose station was in the rear of the British line, perceiving that the Spaniards were bearing up before the wind, with an intention of forming line and joining their separated ships, or of avoiding an engagement, disobeyed the signal without a moment's hesitation, and ordered his ship to be wore. This at once brought him into action with seven of the enemy's ships, four of which were first-rates. But he was nobly supported by Troubridge in the Culloden; and the Blenheim also came to his assistance. The Salvador del Mundo and San Isidro dropped astern, and were fired into with tremendous effect by the Excellent, Captain Collingwood, to whom the latter struck. At this moment the Captain was closely engaged with three first-rates, the San Nicolas, an eighty-gun ship, and a seventy-four; the Blenheim was ahead, and the Culloden, crippled, had drifted astern. Disdaining the parade of taking possession of beaten enemies, Collingwood immediately ranged up, passed within ten feet of the San Nicolas, giving her a tremendous broadside, and then pushed on for the Santissima Trinidad of 136 guns. The San Nicolas having luffed up, the San Joseph fell on board of her, and Nelson resumed his station abreast of them, and close alongside. The Captain being now incapable of further service, either in the line or in chase, Nelson directed the helm to be put a-starboard, and calling the boarders, ordered them to board. The San Nicolas was carried after a short struggle, and the San Joseph boarded from the San Nicolas, Nelson himself leading the way, and exclaiming, "Westminster Abbey or victory." This was the work of an instant; but before Nelson could reach the quarter-deck of the Spanish ship, an officer looked over the rail, and said they surrendered. This daring achievement was effected with comparatively small loss, and Nelson himself received only a few bruises. The Captain, however, had suffered severely in the action. She had lost her fore-top-mast; not a sail, shroud, nor rope was left; her wheel had been shot away; and a fourth part of the loss sustained by the whole squadron had fallen upon that single ship.

The Spaniards had still eighteen or nineteen ships which had suffered little or no injury; that part of the fleet which had been separated from the main body in the morning was now coming up; and Sir John Jervis made the signal to bring to. The enemy, however, did not venture to renew the combat; and, as soon as the action was discontinued, Nelson went on board the admiral's ship. Sir John Jervis received him with open arms, and said he could not sufficiently thank him. For this victory the commander-in-chief was rewarded with a peerage and the title of Earl St Vincent; whilst Nelson, who, before the action was known in England, had been advanced to the rank of rear-admiral, received the insignia of the Bath, and a gold medal from his sovereign.

In April 1797, Sir Horatio Nelson, having hoisted his flag as rear-admiral of the blue, was sent to bring away the troops from Porto Ferrajo; and having performed this service, he shifted his flag to the Theseus, a ship which had taken part in the mutiny in England. Whilst in the Theseus, he was employed in the command of the inner squadron at the blockade of Cadiz. During this service, his personal courage was eminently signalized. In a night attack upon the Spanish gun-boats (3d of July 1797), his barge was assailed by an armed launch, carrying twenty-six men, whilst he had with him only the usual complement of ten men and the cockswain, besides Captain Freemantle. After a severe conflict, hand to hand, eighteen of the enemy were killed, all the rest wounded, and the launch taken. Twelve days after this rencontre, Nelson sailed at the head of an expedition against Teneriffe. It having been ascertained that a homeward-bound Manilla ship had recently put into Santa Cruz, the expedition was undertaken in the hope of capturing this rich prize. But it was not fitted out upon the scale which Nelson had proposed; no troops were embarked; and although the attack was made with great intrepidity, the attempt failed. The boats of the squadron being manned, a landing was effected early in the night, and Santa Cruz taken and occupied for about seven hours; but the assailants, finding it impracticable to storm the citadel, were obliged to prepare for retreat, which they effected without molestation, agreeably to stipulations which had been made with the Spanish governor by Captain Troubridge, whose firmness and presence of mind were conspicuously displayed on this occasion. The total loss of the English in killed, wounded, and drowned, amounted to 250. Nelson himself was amongst the wounded, having, in stepping out of the boat to land, received a shot through the right elbow, which shattered the whole arm, and rendered amputation necessary.

Nelson was now obliged to return to England, where honours awaited him sufficient to cheer his mind amidst the sufferings occasioned by the loss of his arm. Letters were addressed to him by the first lord of the admiralty and the Duke of Clarence; the freedom of the cities of London and Bristol was transmitted to him; he was invested with the order of the Bath; and he also received a pension of L.1000 a year.[1] His sufferings from the lost limb, however, were long and painful. A nerve had been taken up in one of the ligatures at the time of the operation, and besides, the ligature was of silk instead of waxed thread; a circumstance which produced a constant irritation and discharge, until at length, after three months of continual pain, it came away about the end of November. From that time the arm began to heal, and, as soon as he found his health re-established, he sent to a neighbouring church a form of devout thanksgiving to Almighty God for his recovery from a severe wound.

In April 1798, he hoisted his flag on board the Vanguard, and was ordered to rejoin Earl St Vincent. Immediately on his arrival, he was despatched to the Mediterranean with a small squadron, to ascertain, if possible, the object of the great expedition which was then fitting out at Toulon. He sailed from Gibraltar on the 9th of May, with three seventy-fours, four frigates, and a sloop of war. On the 19th the squadron reached the Gulf of Lyons, and on the 22d a violent storm inflicted serious injury on the Vanguard; the main-top-mast went over the side, the mizen-top-mast soon afterwards gave way, the fore-mast went in three pieces, and the boltsprit was found to be sprung in as many places. Captain Ball in the Alexander now took the disabled ship in tow in order

[1] The memorial which, as a matter of course, he was called upon to present on this occasion, exhibited an extraordinary catalogue of services performed during the war. It stated, that he had been in four actions with the fleets of the enemy, and in three actions with frigates, in six engagements against batteries, in ten actions in boats employed in cutting vessels out of harbour or in destroying them, and in taking three towns; that he had served on shore with the army four months, and commanded the batteries at the sieges of Bastia and Calvi; that he had assisted at the capture of seven sail of the line, six frigates, four corvettes, and eleven privateers of different sizes; that he had taken and destroyed nearly fifty sail of merchant-vessels, and had actually been engaged against the enemy upwards of one hundred and twenty times; in which services he had lost his right eye and right arm, and had been severely wounded and bruised in his body. This memorial, which is dated "October 1797," and addressed "to the king's most excellent majesty," is perhaps without a parallel in our naval history; yet what splendid additions were afterwards made by him to the catalogue of his services!

Nelson. to carry her into the harbour of St Pietro, in Sardinia. Nelson, apprehensive that the attempt might endanger both vessels, ordered him to cast her off; but that excellent officer replied that he was confident he could save the Vanguard, and, by God's help, he would do it. Previously to this there had been a coolness between Sir Horatio and Captain Ball; but from this time the former became fully sensible of the great merit of the latter, and a sincere friendship subsisted between them during the remainder of their lives. By extraordinary exertions the Vanguard was refitted in four days; the supply of water was also completed; and he received a reinforcement of ten ships of the line and one of fifty guns, which Lord St Vincent had sent to him under the command of Commodore Troubridge. That officer took with him to Nelson no instructions as to the course he was to steer, nor any certain account of the enemy's destination. Every thing was left to his own judgment. But, unfortunately, the frigates having been separated from him in the tempest, had not yet been able to rejoin; and he was obliged to sail without them. The first news of the enemy's armament was that it had surprised Malta. Nelson now formed a plan for attacking it whilst at anchor at Gozo; but on the 22d of June he received information that the French had left the island on the 16th, the day after their arrival. Thinking it clear that their destination was eastward, he accordingly made all sail for Egypt, and arrived off Alexandria on the 28th; but the enemy were not there, neither could any account of them be obtained. He then shaped his course to the northward for Caramania, and steered along the southern side of Candia, carrying a press of sail night and day, with a contrary wind. The want of the frigates was now severely felt; they were the eyes of the fleet, and if they had not been separated, he could scarcely have failed to gain information of the enemy. Baffled in the pursuit, however, he returned to Sicily, took in what stores he required at Syracuse, and on the 25th of July sailed for the Morea. The period of uncertainty was now approaching its term. On the 28th the squadron made the Gulf of Coron, and Troubridge having entered the port, returned with the intelligence that the French had been seen about a month before steering to the south-east from Candia. On receiving this information, Nelson determined to return immediately to Alexandria; and, accordingly, the British fleet, with every sail set, stood once more for the coast of Egypt. On the 1st of August they came in sight of Alexandria; and, at four in the afternoon, Captain Hood, in the Zealous, made the signal for the French fleet. For several days previous to this the admiral had scarcely taken either food or sleep. He now ordered his dinner to be served, whilst preparations were making for battle; and when his officers rose from table to repair to their several stations, he said to them, "Before this time to-morrow I shall have gained a peerage, or Westminster Abbey."

The French fleet had arrived at Alexandria on the 1st of July; and the admiral, Brueys, not being able to enter the port, which time and neglect had ruined, moored his ships in Aboukir Bay, in a strong and compact line of battle; the headmost vessel being close to a shoal on the north-west, and the rest of the fleet forming a kind of curve along the line of deep water, so as not to be turned by any means on the south-west. The advantage of numbers, both in ships, guns, and men, was in favour of the French. They had thirteen ships of the line and four frigates, carrying 1196 guns, and 11,230 men. The English had the same number of ships of the line, and one fifty-gun ship, carrying 1012 guns and 8068 men. The English ships were all seventy-fours; the French had three eighty-gun ships, and one three-decker of 120 guns. But any disparity of force on the part of the latter was more than compensated by their having such a commander as Nelson. That gallant chief has not left any detailed account of his plan of attack: but it was well understood by the squadron, and has been accurately described by several who assisted in carrying it into execution. It had been his practice, during the pursuit, to have his captains on board the Vanguard, whenever circumstances would permit, and to explain to them his own ideas as to the best modes of attack, and the plans which he proposed to execute on falling in with the enemy, whatever their situation might be. His officers were thus well acquainted with the principles of his tactics; and such was his confidence in their abilities, that the only thing determined on, in case they should find the French at anchor, was that the ships should form in the manner most convenient for mutual support, and then anchor by the stern. But the moment he perceived the position of the enemy, the thought instantly struck him that where there was room for a French ship to swing, there would also be room for one of his to anchor. He, therefore, resolved to keep entirely on the outer side of the French line, and to station his ships, as far as he was able, one on the outer bow, and another on the outer quarter, of each of the enemy's, thus doubling on a certain portion of their line. When he had fully explained his plan of attack, Captain Berry, perceiving the scope of the design, exclaimed with transport, "If we succeed, what will the world say?" "There is no *if* in the case," replied the admiral; "that we shall succeed is certain; but who may live to tell the story is a different question."

The battle commenced at half-past six o'clock, a little before sunset. Captain Foley led the way in the Goliath, out-sailing the Zealous, Captain Hood, which for some minutes disputed with him the post of honour. As the squadron advanced, the enemy opened a steady fire from the starboard side of their line, into the bows of the leading British ships. It was received in silence, whilst the men on board of each ship were employed aloft in furling the sails, and below in tending the braces and making ready for anchoring; a proceeding which told the enemy that escape was impossible. Foley, in the Goliath, intending to fix himself upon the inner bow of the Guerrier, kept as near the edge of the bank as the water would admit; but his anchor hung, and having opened his fire, he drifted to the second ship, the Conquérant, before it was clear, then anchored by the stern, inside of her, and in ten minutes shot away her masts. Hood, in the Zealous, took the station which the Goliath intended to have occupied, and, in twelve minutes, totally disabled the Guerrier. The Orion, Sir James Saumarez, was the next ship which doubled on the enemy's van. Passing to windward of the Zealous, she opened her larboard guns as long as they bore on the Guerrier, then passing inside the Goliath, sunk a frigate, hauled round, and anchoring between the fifth and sixth ships from the Guerrier, took her station on the larboard bow of the Franklin, and the quarter of the Peuple Souverain, receiving and returning the fire of both. The Audacious, Captain Gould, pouring heavy broadsides into the Guerrier and Conquérant, fixed herself on the larboard bow of the latter; and when that ship struck, passed on to the Peuple Souverain. The Theseus, Captain Millar, followed, and having brought down the remaining masts of the Guerrier, anchored inside the Spartiate, the third ship in the French line. Whilst these advanced ships thus doubled on the enemy's line, the Vanguard was the first which anchored on the outer side, within half pistol-shot of the Spartiate. Nelson veered half a cable, and instantly opened a tremendous fire, under cover of which the four other ships of his division sailed ahead of the admiral. In a few minutes every man stationed at the first six guns in the fore part of the Vanguard was either killed or wounded; and these guns were three times cleared. The Minotaur, Captain Louis, anchored next ahead, and took off the fire of the Aquilon, the enemy's fourth ship. The Bellerophon, Captain Darby, passed ahead, and dropped her stern anchor on the starboard bow of the Orient, Bruey's own ship, of 120 guns. Captain Peyton, in the Defence, now took his station ahead of the Minotaur, and engaged the Franklin, the enemy's sixth ship, by which judicious movement the British line remained unbroken. The Majestic, Captain Westcott, got entangled with the main rigging of a French ship astern of the Orient, and suffered severely from the fire of that three-decker; but she at length swung clear, and closely engaged the Heureux, the ninth ship, on the starboard bow, receiving also the fire of the Tonnant, the eighth in the French line.

The four remaining ships of the British squadron, having been detached previously to the discovery of the French fleet, were at a considerable distance when the battle commenced. Troubridge, in the Culloden, the foremost of these ships, was two leagues astern. He came on sounding, as the others had done; but as he advanced the increasing darkness augmented the difficulty of the navigation, and, in rounding the reef, his ship suddenly grounded, and, notwithstanding the greatest exertions, could not be got off in time to bear a part in the action. The Culloden, however, served as a beacon to the Alexander and Swiftsure, which entered the bay, and took their stations amidst the darkness, which was relieved only by the flashes of light from the contending fleets. The Swiftsure, Captain Hallowell, occupied the position from which the Bellerophon, overpowered by the huge Orient, had drifted almost a complete wreck, opening a steady fire on the quarter of the Franklin and the bows of the French flag-ship; and at the same instant the Alexander, Captain Ball, passed under his stern, and anchored within-side, on the larboard quarter of the Orient, raking that ill-fated ship, and keeping up a severe fire of musketry upon her decks. Lastly, the Leander, Captain Thomson, finding that the Culloden could not be got off, advanced with the intention of anchoring athwart hawse of the Orient; but the Franklin being near ahead, there was not room for him to pass clear of the two, and he took his station athwart hawse of that ship, in a position which enabled him to rake both.

The first two ships of the French line had been dismasted within a quarter of an hour after the commencement of the action; and the others had suffered so severely that victory was already certain. At half-past eight o'clock, the third, fourth, and fifth were taken possession of. In the mean time Nelson had received a severe wound on the head from a langridge shot, which cut a large flap of skin from the forehead, and occasioned such an effusion of blood that the injury was at first believed to be mortal. But when the surgeon came to examine the wound, he found that the hurt was merely superficial, and requested that the admiral would remain quiet. Nelson, however, could not rest, and having called for his secretary, had begun to dictate his despatches, when suddenly a cry was heard upon deck that the Orient was on fire. In the confusion, he found his way up unassisted and unnoticed, and having appeared on the quarter-deck, immediately gave orders that boats should be sent to the relief of the enemy. It was about ten minutes after nine o'clock when the fire broke out in the Orient. Brueys was dead. He had received three wounds, yet would not leave his post; and when a fourth cut him almost in two, he desired to be left to die upon deck. In the meanwhile the flames soon mastered the devoted ship, and by the light of the conflagration, the situation of both fleets could be perceived, their colours being clearly distinguishable. About ten o'clock the ship blew up with a tremendous explosion, which was followed by a pause not less awful. The firing immediately ceased; and the first sound which broke the silence was the dash of her shattered masts and yards falling into the water from the vast height to which they had been projected by the explosion. The combat recommenced with the ships to leeward of the centre, and continued till about three in the morning. At day-break on the 2d, the Guillaume Tell and the Généreux were the only ships of the French line which had their colours flying. Not having been engaged, they cut their cables in the forenoon, and stood out to sea, accompanied by two frigates. The Zealous pursued; but as there was no other ship in a condition to support her, she was recalled. Of thirteen sail of the line, nine were taken, and two burnt (the Timoleon having shared the fate of the Orient); and of four frigates, one was burnt and another sunk. In short, it was a conquest rather than a victory. The French fleet had been annihilated; and if the English admiral had been provided with small craft, nothing could have prevented the destruction of the store-ships and transports in the harbour of Alexandria.

Nelson was now at the very summit of glory. Congratulations, rewards, and honours were showered upon him by all the foreign states and powers to which his victory promised a respite from French aggression. In his own country, he was created Baron Nelson of the Nile and of Burnham-Thorpe, with a pension of L.2000 a year for his own life and those of his two immediate successors; a degree of rank which, though it might be the measure of ministerial gratitude, was by no means commensurate with the services for which it was bestowed on him. A grant of L.10,000 was voted to Nelson by the East India Company; the Turkish Company presented him with a piece of plate; and the city of London bestowed honorary swords on the admiral and on each of his captains. In the distribution of rewards, he was particularly anxious that the captain and first lieutenant of the Culloden should not be passed over because of their misfortune. "It was Troubridge," said he, in addressing the admiralty, "who equipped the squadron so soon at Syracuse; it was Troubridge who exerted himself for me, after the action; it was Troubridge who saved the Culloden, when none that I know in the service would have attempted it." As the ship had not been engaged, however, it was thought necessary to make an exception as to the captain; but Nelson was desired to promote the lieutenant upon the first vacancy that should occur.

Having made the necessary arrangements in regard to the prizes, and left a squadron before Alexandria, Nelson stood out to sea on the seventeenth day after the battle, and early on the 22d of September appeared in sight of Naples, where the Culloden and Alexander had preceded him, and given notice of his approach. Here he was received with every demonstration of joy and triumph, both by the royal family and the people, and formed that unfortunate connection with Lady Hamilton which exercised so baneful an influence on the rest of his life. The state of Naples at this period was deplorable. The king, like the rest of his race, was passionately fond of field-sports, and cared for almost nothing else. The queen had all the vices of the house of Austria, with little to mitigate and nothing to ennoble them. The people were sunk in ignorance, and debased by misgovernment; at once turbulent and cowardly, ferocious and indolent, irreligious and fanatical. Nelson was fully sensible of the depravity and weakness of all by whom he was surrounded; yet, seduced by the blandishments of the queen, the flatteries of the court, and the pernicious influence which Lady Hamilton now began to exercise over his mind, he suffered himself to be implicated in transactions which compromised the honour of his country, and deeply tarnished his hitherto unsullied fame. The defeat of Mack at Castellana, and the advance of the French towards Naples, were followed by the flight of the royal family, who were conveyed by Nelson to Palermo. After this an armistice was signed (10th of January 1799), by which the greater part of the kingdom was given up to the enemy; and this cession necessarily led to the loss of the whole. Naples was occupied by the French under Championnet, and the short-lived Parthenopean republic soon afterwards established. But the successes of the allies in Italy speedily changed the face of affairs, and prepared the way for the restoration of the exiled monarch.

Relying on the diminished numbers of the enemy, whose force had been greatly reduced, the royalists took the field, and Cardinal Ruffo appeared at the head of an armed rabble, which he called the Christian army. Captain Foote, in the Seahorse, with some Neapolitan frigates, and a few smaller vessels, was ordered to co-operate with this force, and to give it all the assistance in his power. Ruffo, advancing without any plan, but ready to take advantage of any accident which might occur, now approached Naples. Fort St Elmo, which commands the city, was garrisoned by French troops; but the castles of Uovo and Nuovo, commanding the anchorage, were chiefly defended by the Neapolitan "patriots," the leading men amongst them having taken shelter there. As the possession of these castles would greatly facilitate the reduction of Fort St Elmo, Ruffo proposed to the garrison to capitulate, on condition that their persons and property should be respected, and that they should, at their own option, either be sent to Toulon or remain at Naples, without being molested in their persons. These terms were accepted, and the capitulation was signed by the cardinal, the Russian and Turkish commanders, and also by Captain Foote as commanding the British force. But Nelson, who soon afterwards arrived in the bay with a large fleet, made a signal to annul the treaty, declaring that he would grant to rebels no other terms than those of unconditional submission; and, notwithstanding the strenuous opposition of the cardinal, who protested that a treaty solemnly concluded could not be honourably set aside, the garrisons of the castles were delivered over as rebels to the vengeance of the Sicilian court. The tragedy which followed formed an appropriate sequel to this disgraceful and infamous transaction. The aged Prince Caraccioli, a man of high character and great personal merit, was accused of having joined the enemy, and, after a sham trial by a court-martial of Neapolitan officers assembled on board the British flagship, found guilty, and sentenced to death; and this sentence Lord Nelson ordered to be carried into execution the same evening, on board of the Sicilian frigate La Minerva. He was arrested at nine in the morning, put on his trial at ten, condemned at twelve, and hanged at the fore-yard-arm of the frigate at five o'clock in the afternoon, after which his body was cut down and thrown into the sea.[1] If any thing could deepen the indignation and abhorrence which these foul deeds are calculated to excite in every honourable and virtuous mind, it would be the circumstance that Nelson accepted from the Sicilian court a reward for services which leave such an indelible stain on his memory. In addition to a sword splendidly enriched with diamonds, he received the dukedom of Bronte, a title which seems to have greatly flattered his vanity, with a domain worth about L.3000 a year.

After the appointment of Lord Keith to the chief command of the fleet in the Mediterranean, Nelson made preparations for his return to England; and, as a ship could not be spared to convey him thither, he travelled through Germany to Hamburg, in company with Sir William and Lady Hamilton, and having embarked at Cuxhaven, landed at Yarmouth on the 6th of November 1800, after an absence of three years from his native country. He was welcomed in England with every mark of popular respect and admiration; in the towns through which he passed the people came out to meet him, and in London he was feasted by the city, drawn by the populace, thanked for his victory by the common council, and presented with a gold-hilted sword studded with diamonds. He had now every earthly blessing except domestic happiness, which, in consequence of his infatuated attachment to Lady Hamilton, he had forfeited for ever. Before he had been three months in England he separated from Lady Nelson, at the same time calling God to witness that there was nothing in her or in her conduct which he could wish otherwise. His best friends remonstrated against this causeless and cruel desertion; but their expostulations produced no other effect than to make him displeased with them, and dissatisfied with himself.

The three northern courts of Denmark, Sweden, and Russia, had now formed a confederacy for the purpose of setting limits to the naval pretensions of Great Britain; and as such a combination, under the influence of France, would soon have become formidable, the British cabinet instantly prepared to crush it. With this view a formidable fleet was fitted out for the North Seas, and the chief command of it given to Sir Hyde Parker; under whom Nelson, who had recently been made vice-admiral of the blue, consented to serve as second in command. The fleet sailed from Yarmouth on the 12th of March 1801; and on the 30th of the same month, Lord Nelson, having shifted his flag from the St George to the Elephant, led the way through the Sound, which was passed without any loss. The Danes, upon whom the storm was now about to burst, were well prepared for defence. Upwards of two hundred pieces of cannon were mounted on the Crown batteries at the entrance of the harbour, and a line of twenty-five two-deckers, frigates, and floating batteries, was moored across its mouth. Besides, the navigation was little known, and extremely intricate; all the buoys had been removed; and the channel was considered as impracticable for so large a fleet. It was apparent, therefore, that the Danes could not be attacked without great difficulty and risk; and in a council of war, held on board of the flag-ship, considerable diversity of opinion prevailed. Nelson, however, cut short the discussion, by offering his services for the attack, requiring only ten sail of the line, and the whole of the smaller craft. Sir Hyde Parker assented, but gave him two more line-of-battle ships than he had asked, and left every thing to his own judgment. On the morning of the 1st of April, the whole fleet moved to an anchorage within two leagues of the town; and, about one o'clock, Nelson hav-

[1] After receiving sentence, Caraccioli requested Lieutenant Parkinson, in whose custody he was, to intercede with Lord Nelson for a new trial. He complained that he had not been allowed time to prove his defence, which was, that he had acted under compulsion; and, in particular, that Count Thurn, who presided at the court-martial, was notoriously his personal enemy. To this Lord Nelson answered, that the prince had been fairly tried by the officers of his own country, and that he could not interfere. But he forgot, that if he felt himself warranted in ordering the trial and the execution, no human being could ever have questioned the propriety of his interfering on the side of mercy. Caraccioli then earnestly entreated that he might be shot, declaring that the disgrace of being hanged was dreadful to him. Even to this supplication Lord Nelson lent a deaf ear, and told the lieutenant to go and attend to his duty. As a last hope, Caraccioli thought of an application to Lady Hamilton; and Lieutenant Parkinson went to seek her. She was not to be seen on this occasion; but she was present at the execution. *Quis talia fando temperet a lacrymis?* Whilst horror thrills through our veins at the conduct of those parties, it is impossible to contemplate without emotion the fate of the aged patriot who was thus cruelly sacrificed.

Nelson. ing completed his last examination of the ground, made the signal to weigh, which was received with a shout throughout the whole division destined for the attack. They weighed with a light and favourable wind, the small craft pointing out the course to be followed; and the whole division, having coasted along the shoal called the Middle Ground, doubled its farther extremity, and anchored there just as the darkness closed, the signal to prepare for action having been made early in the evening. As his anchor dropped, Nelson exclaimed, "I will fight them the moment I have a fair wind."

On the following morning, at half past nine, the signal was made for the ships to weigh in succession; at ten minutes after ten the action commenced, at the distance of about half a cable length from the enemy; and by half-past eleven the battle became general. The plan of attack had been complete; but seldom had any project of the kind been disconcerted by more untoward accidents. The Agamemnon was immoveably aground, at a distance which rendered her entirely useless; the Bellona and the Russell had also grounded in a situation where they could not render half the service that was required of them; of the squadron of gun-brigs, only one could get into action, owing to the baffling currents; and only two bomb-vessels could reach their station on the Middle Ground, where they were to open their fire on the arsenal. Nelson's agitation was extreme when he found himself, before the action began, deprived of a fourth part of his force; but no sooner was he in action than the wild music of the fight seemed to drive away all anxious thoughts; his countenance brightened, and his conversation became joyous, animated, and delightful. At one o'clock the enemy's fire continued unslackened; and the commander-in-chief, despairing of success, made the signal for discontinuing the action. At this moment, whilst Nelson was pacing the quarter-deck in all the excitement of battle, a shot passing through the main-mast, knocked the splinters about. "It is warm work," said he, "and this day may be the last to any of us at a moment; but, mark you," he added, "I would not be elsewhere for thousands." The signal-lieutenant now called out that the signal for discontinuing the action had been thrown out by the commander-in-chief. Nelson continued to walk the deck, and appeared not to notice it. At the next turn, the lieutenant asked if he should repeat the signal. "No," replied Nelson; "acknowledge it." He then called to know if the signal for close action was still hoisted; and being answered in the affirmative, said, "Mind you keep it so." A little after, "I have a right to be blind sometimes, Foley," added he, addressing the captain; then putting the glass to his blind eye, in a mood of sportive bitterness, which gives an inexpressible interest to the scene, "I really do not see the signal," he exclaimed; and, after a pause, "Keep mine for closer battle flying; that's the way I answer such signals; nail mine to the mast."

Between one and two o'clock, however, the fire of the Danes slackened; and about two it ceased along the greater part of their line, and some of their lighter ships were adrift. But it was difficult to take possession of those which had struck, because the batteries on Amak Island protected them, and an irregular fire was still kept up from the ships themselves, the crews being continually reinforced from the shore. By half-past two, however, the action had ceased, except with the Crown batteries, and one or two ships which had renewed their fire, though with but little effect. At this critical moment, Nelson, with a presence of mind peculiar to himself, and never more signally displayed than now, availed himself of the circumstance to secure the advantage he had gained, and to open a negotiation. He retired into the stern gallery, and wrote to the Crown Prince thus: "Vice-Admiral Lord Nelson has been commanded to spare Denmark, when she no longer resists. The line of defence which covered her shores has struck to the British flag; but if the firing is continued on the part of Denmark, he must set on fire all the prizes he has taken, without having the power of saving the men who have so nobly defended them. The brave Danes are the brothers, and should never be the enemies, of the English." This, after an interchange of communications, led to an interview between Nelson and the Crown Prince, at which the preliminaries of negotiations were adjusted; and a treaty was at length concluded, by which the northern confederacy was dissolved, and the maritime superiority of Britain unequivocally recognised. For the battle of Copenhagen, Nelson was raised to the rank of Viscount, and, on the recall of Sir Hyde Parker, appointed to the chief command in the North Sea.

Having settled affairs in the Baltic, Lord Nelson returned in a frigate to England. But he had not been many weeks ashore when he was called upon to undertake a service which might have been equally well executed by a much inferior man. This was an attack on the flotilla which had been prepared at Boulogne for the threatened invasion of England. A force had been got together, with an alacrity that has seldom been equalled; and the attack was made by the boats of the squadron, in five divisions; but the enemy were fully prepared, and, though nothing could exceed the gallantry with which they were assailed, the enterprise proved unsuccessful. Owing to the darkness, the state of the tide, and the uncertainty attending all night attacks, the divisions had separated; and the great effort was not made with that unity which alone can insure success. In his letters to the admiralty, Nelson affirmed, that if our force had arrived as he intended, all the chains and the moorings with which the enemy's flotilla were secured could not have prevented our brave seamen from bringing off the whole of them. Every thing that prudence could suggest had been done; no error had been committed; and never did Englishmen display greater courage. But he now desired to be relieved from this boat-service, thinking it an unsuitable employment for a vice-admiral; and his wishes were speedily gratified by the signature of the preliminaries of peace.

He had purchased a house and an estate at Merton in Surrey, meaning to pass there the remainder of his days, in the society of Sir William and Lady Hamilton. But the happiness which he had promised himself was not of long continuance. Sir William Hamilton died early in 1803. A few weeks subsequent to this event the war was renewed; and the day after his majesty's message to parliament announcing the re-commencement of hostilities, Lord Nelson departed to assume the command of the fleet in the Mediterranean.

On the 20th of May 1803, he hoisted his flag on board the Victory, and having taken his station immediately off Toulon, he there waited with incessant watchfulness for the coming out of the enemy. This blockade proved one of the longest and most persevering that have been recorded in our naval annals; yet notwithstanding all his vigilance, the Toulon fleet put to sea on the 18th of January 1805, and shortly afterwards formed a junction with the Spanish squadron at Cadiz, Sir John Orde, who commanded off that port, having retired at their approach. Nelson had formed his own judgment of their destination, when Donald Campbell, then an admiral in the Portuguese service, went on board of the Victory, and communicated his certain knowledge that the combined French and Spanish fleets were bound for the West Indies. The enemy had five and thirty days start; but Nelson calculated that he should gain eight or ten days by his exertions. To the West Indies therefore he bent all sail, and on the 4th of June reached Barbadoes, whither he had sent despatches before him. Deceived by false intelligence, he then stood to the southward in quest of the enemy; but advices having met him by the way, that the combined fleets were at Martinique, he immediately sailed for that island, where he arrived on the 9th, and received certain intelligence that they had passed to the leeward of Antigua the preceding day, and taken a homeward-bound convoy. It was now clear that the enemy, having accomplished the object of their cruize, were flying back to Europe; and accordingly, on the 13th, he steered for Europe in pursuit of them. On the 17th July he came in sight of Cape St Vincent, and directed his course towards Gibraltar, where he soon afterwards anchored, and went on shore for the first time since the 16th of June 1803. The combined fleet having thus eluded his pursuit, he returned almost inconsolable to England, to reinforce the Channel fleet with his squadron, lest the enemy should bear down upon Brest with their whole collected force.

Having landed at Portsmouth, Lord Nelson at length received news of the enemy's fleet. After an inconclusive action, in which they had run the gauntlet through Sir Robert Calder's squadron on the 22d of July, about sixty leagues west of Cape Finisterre, they had proceeded to Ferrol, brought out the squadron which there awaited their arrival, and with it entered Cadiz in safety. Upon receiving this intelligence, Nelson again offered his services, which were willingly accepted; and Lord Barham, then at the head of the admiralty, gave him a list of the navy, desiring him to choose his own officers. No appointment could be more in unison with the feelings and judgment of the nation. The Victory, destined once more to bear his flag, was refitted with incredible despatch; and such was his impatience to be at the scene of action, that although the wind proved adverse, he worked down the Channel, and, after a rough passage, arrived off Cadiz on the 29th of September, the day on which the French admiral, Villeneuve, had received peremptory orders to put to sea the very first opportunity. Fearing that the enemy, if they knew his force, might be deterred from venturing to sea, he kept out of sight of land; desired Collingwood to hoist no colours, and fire no salute; and wrote to Gibraltar to request that the force of the fleet might not be inserted in the gazette published there. The station which he chose was some fifty or sixty miles to the westward of Cadiz, off Cape St Mary's. At this distance, he hoped to induce the enemy to come out, whilst he guarded against the danger of being caught by a westerly wind near Cadiz, and driven within the Straits. In the meanwhile the blockade of the port was rigorously enforced; and a line of frigates communicated between him and the squadron of eight or nine sail left before Cadiz, so as to give him the earliest intelligence of the enemy's movements. The advantage of this plan was, that he could receive supplies and reinforcements without the enemy being informed of it; whilst, by preventing the entrance of neutral vessels into Cadiz, the combined fleets were deprived of both. Accident also contributed to mislead Villeneuve, by inducing him to doubt whether Nelson himself had actually assumed the command. An American, lately arrived from England, assured him it was impossible this could be the case, for he had seen the English admiral only a few days before in London, and at that time there was no rumour of his going again to sea.

On the 9th of October, Lord Nelson communicated to Admiral Collingwood his plan of attack. The order of sailing was to be the order of battle; the fleet formed in two lines, with an advanced squadron of the fastest-sailing two-deckers. The second in command, having the entire direction of his line, was to break through the enemy's line about the twelfth ship from their rear; he himself was to lead through the centre; and the advanced squadron were to cut off three or four ahead of the centre. This plan was adapted to the strength of the enemy, and had for its object to render the two lines, and the squadron ahead, one-fourth superior in force to those they cut off. His object he declared to be, close and decisive action. "In case signals cannot be seen or clearly understood," said he, "no captain can do wrong if he place his ship alongside that of an enemy." This was what he called the *Nelson-touch*. It was a mode of attack equally new and simple. Every one comprehended it in a moment, and was convinced that it would succeed. In fact, it proved irresistible.

Villeneuve, relying upon the information he had received, put to sea on the 19th, and at day-break on the 21st of October the combined fleets were distinctly seen from the deck of the Victory, formed in a close line ahead, about twelve miles to the leeward, and standing to the southward, off Cape Trafalgar. The British fleet consisted of twenty-seven sail of the line, and four frigates; the enemy's fleet, of thirty-three sail of the line, and seven frigates. But their superiority was greater in size and in weight of metal than in numbers; they had 4000 troops on board; and the best riflemen who could be procured, many of them Tyrolese, were dispersed throughout the ships. Soon after day-light Nelson came on deck, and the signal was made to bear down on the enemy in two lines, upon which the fleet set all sail; Collingwood, in the Royal Sovereign, leading the lee line of thirteen ships, and Nelson, in the Victory, leading the weather line of fourteen. Having seen that all was right, he retired to his cabin, and wrote a devout prayer, in which, after beseeching the Almighty to grant a great and glorious victory, he committed his life to the God of Battles; and in another writing which he annexed in the same diary, he bequeathed Lady Hamilton as a legacy to his king and country, and commended to the public beneficence his adopted daughter, Horatia, desiring that in future she would use the name of Nelson only. Blackwood went on board the Victory about six, and found him in good spirits, but very calm, and with none of that exhilaration which he had displayed on entering into battle at Aboukir and at Copenhagen. With a prophetic anticipation, he seems to have looked for death with almost as certain a conviction as for victory. His whole attention was fixed upon the enemy, who now formed their line on the larboard tack; thus bringing the shoals of Trafalgar and St Pedro under the lee of the British, and keeping the port of Cadiz open for themselves. This was most judiciously done; and Nelson, aware of the advantages it gave them, made signal to prepare to anchor. But Villeneuve, though a skilful seaman, did not profit by this manœuvre, nor attempt to evade the combat. His plan of defence was as well conceived, and as original, as that of the attack. He had formed his fleet in a double line, every alternate ship being about a cable's length to windward of her second ahead and astern, and offered battle in the most handsome manner, being apparently determined to risk a fair trial of strength.[1] On the other hand, Nelson, being certain of a triumphant issue to

[1] Of the advantages or disadvantages of the mode of attack adopted by the British fleet, it may be considered as presumptuous to speak, since the event proved so completely successful; but as the necessity of any particular experiment frequently depends upon contingent circumstances, not originally calculated on, there can be no impropriety in questioning whether the same plan would succeed in all circumstances, and on all occasions. The original plan of attack was suggested on the supposition that the enemy's fleet consisted of forty-six sail of the line, and the British of forty; it was intended to be made from the windward; and on the supposition that the hostile fleet would be in a line ahead, the British fleet was to be brought within gun-shot of the enemy's centre, in two divisions of sixteen sail each, with a division of observation consisting of the remaining eight ships. The lee division was to make an attack under all possible sail on the twelve rear ships of the enemy; it was to break through the enemy's line, and such ships as might be thrown

the day, declared to Captain Blackwood that he would not be satisfied with less than twenty of the enemy's ships. Then appeared that signal, Nelson's last signal, which will be remembered as long as the language or even the memory of England shall endure: "England expects every man to do his duty." It was received throughout the fleet with a responsive burst of acclamation, rendered sublime by the spirit which it breathed, and the determination it expressed. "Now," said Nelson, "I can do no more. We must trust to the great disposer of all events, and the justice of our cause. I thank God for this great opportunity of doing my duty."

On this memorable day, Nelson wore, as usual, his admiral's frock coat, bearing upon the left breast the various orders with which he had at different times been invested. Decorations which rendered him so conspicuous a mark to the enemy were beheld with ominous apprehension by his officers; especially as it was known that there were riflemen on board the French ships, and it could not be doubted that his life would be particularly aimed at. This was a point, however, on which it was hopeless to reason or remonstrate with him. "In honour I gained them," said he, when allusion was made to the insignia he wore, "and in honour I will die with them." Nevertheless, Captain Blackwood, and his own captain, Hardy, having represented to him how advantageous it would be to the fleet were he to keep out of action as long as possible, he consented that the Temeraire and the Leviathan, which were sailing abreast of the Victory, should be ordered to pass ahead. But the order was unavailing; for these ships could not pass ahead if the Victory continued to carry all her sail; yet, so far from shortening sail, Nelson took an evident pleasure in pressing on, and rendering it impossible for them to obey his own order. As the enemy showed no colours till late in the action, the Santissima Trinidad was distinguishable only by her four decks; and to the bow of his old opponent in the action off Cape St Vincent he ordered the Victory to be steered. In the mean time, an incessant raking fire was kept up on the Victory; and as the ship approached, Nelson remarked, "This is too warm work to last long." She had not yet returned a single gun, though by this time fifty of her men had been killed or wounded, and her main-top-mast with all her studding-sails and booms shot away. A few minutes after twelve, however, she opened her fire from both sides of her deck, and soon afterwards ran on board the Redoubtable, just as her tiller ropes were shot away. Captain Harvey, in the Temeraire, fell on board the Redoubtable on the other side; and another enemy's ship, the Fougueux, fell on board the Temeraire; so that these four ships formed as compact a tier as if they had been moored together, their heads lying all the same way. The lieutenants of the Victory now depressed their guns, and fired with a diminished charge, lest the shot should pass through and injure the Temeraire; and as there was danger that the Redoubtable might take fire from the lower-deck guns, the muzzles of which, when run out, touched her sides, the fireman of each gun stood ready with a bucket of water, which, as soon as the gun had been discharged, he dashed into the hole made by the shot. In this situation, the Victory kept up an incessant fire from both sides, directing her larboard guns on the Bucentaur and Santissima Trinidad.

But Nelson's hour was now come. It had been part of his prayer that the British fleet might be as distinguished for humanity in victory as for bravery in battle. Setting an example himself, he twice gave orders to cease firing upon the Redoubtable, supposing she had struck, because her great guns were silent; for as she carried no flag, it was impossible instantly to ascertain the fact. From the ship which he had thus twice spared he received his death-wound. In the heat of the action, about a quarter after one o'clock, a musket-ball from the mizen-top of the Redoubtable struck the epaulette on his left shoulder; and he fell upon his face on the spot covered with the blood of his secretary, Mr Scott, who had been killed a short time before. "They have done for me at last, Hardy," said he, as a serjeant of marines and two seamen raised him from the deck. "I hope not," replied Captain Hardy. "Yes," he rejoined; "my back bone is shot through." But, though mortally wounded, he did not for a moment lose that presence of mind for which he was ever distinguished. As they were carrying him down the ladder to the cockpit, he observed that the tiller ropes, which had been shot

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out of their stations were to assist those of their friends who should be hard pressed. The remainder of the enemy's fleet were to be left to the management of the commander-in-chief.

Now, if this plan had been adhered to, the English fleet would have borne up together, and sailed in two lines abreast in their respective divisions, until they came up with the enemy; the plan which consideration had matured would have been executed; the victory would have been more speedily decided; and the brunt of the action would have been more equally felt. An attack made in two great divisions, with a squadron of observation, seems to combine every necessary precaution, under all circumstances. The power of bringing an overwhelming force against a particular point of an enemy's fleet, so as to insure the capture of the ships attacked, and afterwards concentrating such a force as may be sufficient not only to protect the attacking ships from any offensive attempt which may be made against them by the unoccupied vessels of the enemy, but also to secure the prizes already made, will most probably lead to victory, perhaps to the annihilation of the greater part, if not the whole, of the fleet thus attacked.

The mode of attack adopted with such success at Trafalgar had, however, few or none of these advantages. The attacking force was brought forward so leisurely and successively, that an enemy of equal spirit, and equal ability in seamanship and gunnery, would have destroyed the ships in detail one after another, carried on, as they were, slowly by a heavy swell and by light airs. This may easily be demonstrated. Besides, whilst the fleet was advancing to the attack on the 21st of October, the weather was exactly such as might have produced this result, seeing that when the battle began the sternmost ships of the British were still six or seven miles distant. By the mode of attacking in detail, and the manner in which the combined fleet was drawn up to receive it, the British, instead of doubling on the enemy, were themselves doubled and tripled on, and the advantage of applying an overwhelming force collectively was thus totally lost. The Victory, Temeraire, Belleisle, Mars, Colossus, and Bellerophon, were placed in such situations at the onset, that nothing but the most heroic gallantry and great practical skill at the guns could have extricated them. If the enemy's vessels had closed up from van to rear, as they ought to have done, and if their crews had possessed a nearer equality in active courage, it may be doubted whether even British skill and gallantry would have availed; the position of the combined fleet being precisely that in which the British were desirous of being placed, namely, having part of the opposing fleet doubled on, and separated from the main body. The attack, however, succeeded, in spite of all these disadvantages; first, from the enthusiasm inspired throughout the fleet by having Nelson to command them; secondly, from the gallant conduct of the leaders of the two grand divisions; thirdly, from the individual exertions of each ship after the attack commenced, and the superior practice of the guns; fourthly, from the consternation spread throughout the combined fleet on finding the British so much stronger than had been expected; fifthly, from the rapid destruction which followed the attack of the two leaders, and which was witnessed by both fleets; and, lastly, from the loss of the French admiral's ship early in the action. Nelson knew his means, and the power he had to deal with; he also knew that the means he adopted were sufficient for the occasion. But as the mode of attack executed at Trafalgar might be followed under different circumstances, and have a different result, it is right to state both its merits and defects; nor can this detract, in any degree, from the fame of Nelson, whose whole professional career was marked throughout by genius and originality, allied with heroic daring and judicious enterprise.

Nelson. away early in the action, were not yet replaced, and ordered that new ones should be immediately rove. He was laid upon a pallet in the midshipman's berth, and, the surgeon being called, it was soon perceived that the wound he had received would speedily prove mortal; but this was concealed from all except Captain Hardy, the chaplain, and the medical attendants. Being certain, however, from the sensation which he felt in his back, and the gush of blood within his breast, that no human aid could avail him, he insisted that the surgeon should leave him, and attend to those to whom he might be useful. "You can do nothing for me," said he. Suffering from intense thirst, and in great pain, he expressed much anxiety as to the fate of the action; and his countenance brightened with a gleam of joy as often as the hurra of the crew of the Victory announced that an enemy's ship had struck.

At length he became very impatient to see Captain Hardy, whom he repeatedly sent for; but that officer could not leave the deck, and upwards of an hour elapsed before he could quit his station. When they met, they shook hands in silence, Hardy struggling to suppress his emotions. "Well, Hardy," said Nelson, "how goes the day with us?" "Very well," replied the captain; "ten ships have struck, but five of the enemy's van have tacked, and show an intention of bearing down on the Victory. I have called two or three of our fresh ships round, and have no doubt of giving them a drubbing." "I hope," said Nelson, "none of our ships have struck." "There is no fear of that," answered Hardy; upon which the dying hero said, "I am a dead man; I am going fast; it will soon be all over with me; my back is shot through." Hardy, unable any longer to suppress his feelings, hastened upon deck; but, in some fifty minutes, returned, and taking the hand of his dying commander, congratulated him on having gained a complete victory. He did not know how many of the enemy had struck, as it was impossible to perceive them distinctly; but fourteen or fifteen at least had surrendered. "That's well," answered Nelson; "but I had bargained for twenty." Then, in a stronger voice, he said, "Anchor, Hardy, anchor;" and again, most earnestly, "Do you anchor." Next to his country, Lady Hamilton occupied his thoughts. "Take care of my dear Lady Hamilton, Hardy; take care of poor Lady Hamilton;" and, a few minutes before he expired, he said to the chaplain, "Remember that I leave Lady Hamilton and my daughter Horatia as a legacy to my country." The last words he was heard to utter distinctly were, "I thank God, I have done my duty." He expired at half-past four o'clock, three hours and a quarter after he had received his fatal wound.

The total loss of the British in the battle of Trafalgar amounted to 1587. Twenty of the enemy struck, and, of the ships which escaped, four were afterwards taken by Sir Richard Strahan. But unhappily the fleet did not anchor, as Lord Nelson with his dying breath had enjoined; a heavy gale came on from the south-west; some of the prizes went down, some were driven on the shore, one effected its escape into Cadiz, others were destroyed, and four only were, by the greatest exertions, saved. Still, by this mighty achievement, the navies of France and Spain received a blow from which they have not yet recovered; the gigantic combinations of Napoleon, with a view to a descent upon England, were completely baffled; and the success of his campaign of Austerlitz was not only compensated, but in a great measure neutralised. It is needless to add, that all the honours which a grateful country could bestow were heaped on the memory of the man who had achieved this unequalled victory.

In Lord Nelson's professional character were united all the highest qualities of a great commander; wonderful foresight, prompt judgment, never-failing presence of mind, ardent zeal, unbounded confidence in the resources of his own mind, and that intuitive decision in the midst of difficulty and peril, which, after all, is the distinguishing attribute of great military or naval genius. His daring was without rashness, and his enterprise based upon the most skilful calculation; his ardour never outrun his understanding, nor his love of glory a due consideration of the material and moral means by which alone success can be obtained. His talents for command were of the highest order, and he knew the invaluable secret of inspiring other men with confidence in him, as well as with confidence in themselves. But the best character which can be drawn of him is the history of his achievements, all stamped with the impression of his genius; and, that nothing might be wanting to the consummation of his renown, he departed in a bright blaze of glory, leaving to his country a name which is her pride and boast, and an example which will continue to be her shield and her strength. (See Southey's *Life of Nelson*, in two vols. 12mo; *Life* by Clarke and M'Arthur, 8vo; Ekins' *Naval History*, 4to; and James's *Naval History*, 6 vols. 8vo.) (A.)

Nemea ‖ Nemesis.

NEMEA, in *Ancient Geography*, a place situated between Cleonæ and Philus, in Argolis; but whether town, district, or something else, is uncertain. There stood a grove, in which the Argives celebrated the Nemean games; and there happened all the fabulous circumstances of the Nemean lion.

NEMEAN GAMES, so called from Nemea, a place situated between the cities of Cleonæ and Philus, where they were celebrated every third year. The exercises consisted of chariot-races, and all parts of the pentathlum. These games were instituted in memory of Opheltes or Archemorus, the son of Euphetes and Creusa, nursed by Hypsipele, who, leaving him in a meadow whilst she went to show the besiegers of Thebes a fountain, found him dead on her return, and a serpent twined about his neck; and hence the fountain, before called *Langia*, was named *Archemorus*, and these games were instituted to comfort Hypsipele. Some, however, ascribe their institution to Hercules, after his victory over the Nemean lion; whilst others think that they were instituted first in honour of Archemorus, but intermitted, and afterwards revived again by Hercules. The victors were crowned with parsley, an herb used at funerals, and fabled to have sprung from Archemorus's blood. The Argives presided at these games.

NEMESIANUS, Aurelius Olympius, a Latin poet who was born at Carthage, and flourished about the year 281 of our era, under the Emperor Carus, and his sons Carinus and Numerian, the last of whom was so fond of poetry that he contested the glory with Nemesianus, who had written a poem upon fishing and maritime affairs. We have still remaining a poem of this author called *Cynegeticon*, and four eclogues, which were published by Paulus Manutius in 1538, by Barthelet in 1613, and at Leyden in 1653, with the notes of Janus Vlitias. Giraldi has preserved a fragment of Nemesianus, which was communicated to him by Sannazarius, to whom we are indebted for this poet's works, which, having been found written in Gothic characters, he caused to be converted into the Roman, and then sent to Paulus Manutius. Although this poem has acquired some reputation, it is greatly inferior to those of Oppian and Gratian upon the same subject; yet the style of Nemesianus is natural enough, and has even some degree of elegance. The world was so much possessed with an opinion of his poem in the eighth century, that it was read amongst the classics in the public schools; particularly in the time of Charlemagne, as appears from a letter of the celebrated Hincmar, bishop of Rheims, to his nephew Hincmar of Laon.

NEMESIS, in pagan worship, the daughter of Jupiter and Necessity, or, according to others, of Oceanus and

Nemesius || Nemenia.

Nox, and who had the care of revenging the crimes which human justice left unpunished. She was also called Adrastæa, because Adrastus king of Argos was the first who raised to her an altar; and Rhamnusia, from her having a magnificent temple at Rhamnus in Attica. She had likewise a temple in the Capitol at Rome. Nemesis is represented with a stern countenance, holding a whip in one hand and a pair of scales in the other.

NEMESIUS, a Greek philosopher who embraced Christianity, and was made bishop of Emesa, in Phœnicia, his birthplace. He flourished in the beginning of the fifth century. There is a work of his extant, entitled *De Natura Hominis*, in which he refutes the fatality of the Stoics, as well as the errors of the Manicheans, the Apolinarists, and the Eunomians; but he espouses the opinion of Origen concerning the pre-existence of souls. This treatise was translated by Valla, and printed in the year 1535. Another version of it was afterwards made by Ellebodius, and printed in 1665; it is also inserted in the *Bibliotheca Patrum*, in Greek and in Latin. Lastly, an edition was published at Oxford in 1671, folio, with a learned preface, in which the editor endeavours to prove, from a passage in this book, that the circulation of the blood was known to Nemesius; an opinion, however, which has since been shown to be a mistake. (See Freind's *History of Physic.*)

NEMOURS, a town of France, in the department of the Seine and Marne, being situated on the river Loing, eleven miles south from Fontainbleau. It was erected into a duchy in the fourteenth century, and has been in the house of Orleans since the time of Louis XIV. It has a considerable trade in corn, wine, and other articles. The population in 1837 amounted to 3839. Long. 2. 41. E. Lat. 48. 15. N.

NENAGH, a market-town of Ireland, in the county of Tipperary and province of Munster, ninety-five miles south-west from Dublin. It is situated upon the Nenagh River, a little to the southward of its union with the Shannon, before it reaches Lough Derg. The town enjoys a good general country trade, but has no manufactures properly so called. Here are the ruins of an ancient castle, called Nenagh Round; also those of an hospital founded in the year 1200, for canons following the rule of St Augustin. There are four fairs held here in the course of the year. The population of the town amounts to 6335.

NENIA, or NÆNIA, in ancient Latin poetry, a kind of funeral song sung to the music of flutes at the obsequies of the dead. Authors represent the nænia as sorry compositions, sung by hired female mourners, called *præficæ*. The first rise of these nænia are ascribed to the physicians. In the heathen antiquity, the goddess of tears and funerals was called *Nenia*, whom some suppose to have given that name to the funeral song, and others to have taken her name from it.

NEOMENIA, or NOUMENIA, a festival of the ancient Greeks, celebrated at the beginning of every lunar month. As the name imports, it was observed upon the day of the new moon, in honour of all the gods, but especially Apollo, who was called *Neomenios*, because the sun is the fountain of light; and whatever distinction of times and seasons may be made on account of other planets, yet they are all owing to him as the original of those borrowed rays by which they shine. The games and public entertainments at these festivals were provided by the rich, to whose tables the poor flocked in great numbers. The Athenians at these times offered solemn prayers and sacrifices for the prosperity of their country during the ensuing month.

The Jews had also their neomenia, or feast of the new moon, on which peculiar sacrifices were appointed; on this day also they had a sort of family entertainment and rejoicing. But the most celebrated neomenia was that at the beginning of the civil year, or first day of the month Tisri, on which no servile labour was performed; and the people then offered particular burnt sacrifices, sounding the trumpets of the temple. The modern Jews keep the neomenia only as a feast of devotion, which any one may observe or not as he pleases.

Neophytes || Nepaul.

NEOPHYTES, or new plants, a name given by the ancient Christians to those heathens who had newly embraced the faith, such persons being considered as regenerated, or born anew by baptism. The term *neophytes* has also been used for new priests, or those just admitted into orders; and sometimes for the novices in monasteries or convents. It is still applied to the converts made by the missionaries amongst the infidels.

NEOTS, ST, a market-town of the county of Huntingdon, in the hundred of Toesland, fifty-six miles from London. It stands on the navigable river Ouse, over which there is a fine stone bridge. It is a well-built place, with a large market-place, and has a handsome church, with an elegant and lofty spire. It has a good market, which is held on Thursday. The population amounted in 1801 to 1752, in 1811 to 1998, in 1821 to 2272; and in 1831 to 2617.

NEOTS, *St*, a town of the county of Cornwall, in the hundred of West, distant 226 miles from London. It is said to have been built by a relation of King Alfred, who died here in 899, and was buried at the place of the same name in Huntingdonshire. The population amounted in 1801 to 906, in 1811 to 1041, in 1821 to 1255, and in 1831 to 1424.

NEPAUL, an extensive country of Hindustan, long and narrow in its form, and, although somewhat curtailed in its dimensions by the progress of British conquest, still one of the largest and most compact independent kingdoms in the country. To the north it is bounded by the great mountain wall of the Himalayas, which separates it from Thibet; to the south the Nepaul territory reaches about twenty miles beyond the base of the mountains, into the plains, being bounded by the provinces of Delhi, Oude, Bahar, and Bengal, with the exception of about sixty miles of territory belonging to the nabob of Oude, which intervene; to the east the river Mitchee separates Nepaul from the British territories; and thence it is bounded by the principality of Sikkim, which extends to the Chinese frontier. Previously to the late war with Britain, the conquests of the Ghoorkhas or Nepaulese extended to the banks of the Sutlege, the eastern river of the Punjab; but the boundary is now the river Cali, or the western branch of the Goggra, which separates the Ghoorkha territory from the British province of Kumaon. The above limits, however, include a territory much larger than that to which the peculiar name of Nepaul Proper belongs, and made up of conquests gained by the Ghoorkhas within the last sixty years from a variety of petty hill states. This extended dominion is mostly included between the twenty-seventh and thirty-first degrees of north latitude, and in extreme length may be estimated at 460 miles, by 115 miles in breadth. The following are the modern districts into which this territory is divided:

1. Nepaul Proper.
2. Country of the twenty-four rajahs.
3. Country of the twenty-two rajahs.
4. Muckwanpoor.
5. Kirauts.
6. Khatang.
7. Chayenpoor.
8. Saptari.
9. Morung.

Aspect of the country.

Nepaul comprehends the greater part, probably about two thirds, of Northern Hindustan. It is accordingly extremely diversified in its surface, the mountains which form its northern boundary rising to the level of perpetual snow. These high mountains generally decline into lower hills, from which they are separated by fine valleys, which are still considerably above the level of the plains, and the lowest belt of the Nepaul dominions forms part of the great plain of Hindustan. Immediately to the north of this flat country there is a region of nearly the same width, consisting of small hills, which rise gra-

Nepaul. dually towards the north, and are watered by many streams from the loftier mountains to which these hills gradually unite. The hills are covered with forests: on the lower hills are found the saul forests, which, with the pines, are not surpassed in any country, either for straightness or size, as well as for strength and durability. Higher up there is a variety of other trees, and amongst the northern hills many pines, and an abundance of mimosa, from which the catechu or Indian rubber is made; also oaks, walnut and chestnut trees, hornbeam, Weymouth pine, and common spruce, for the most part of but very little value, owing to the inaccessible nature of the country. The breadth of this mountainous belt immediately north and east of Catmandoo is estimated at from thirty to forty miles. This is a very elevated region, consisting of one mountain heaped upon another rising to a great height, so that in winter their summits are for a short time covered with snow, and it even falls sometimes in the valley below. A hoar frost also very often covers the ground; but although the cold is occasionally for three or four months severe enough to freeze the tanks and pools of standing water, the rivers are never frozen. Between the mountains are narrow valleys of from 3000 to 6000 feet above the plains of Bengal. The height of the valley of Nepaul, measured by the barometer, is about 4000 feet. It is nearly of an oval figure; its greatest extent from north to south is twelve miles, and it stretches east and west nine miles; and though it scarcely lies in a higher latitude than twenty-seven and a half degrees, yet it enjoys nearly the same climate as the southern countries of Europe.

Climate. Lying near a region buried in snow, its climate must no doubt be somewhat modified by such a vicinity. Still Kirkpatrick mentions, that in summer the thermometer rose once to eighty-seven degrees during his residence in the valley; and its usual height about noon varied from eighty-one to eighty-four degrees. At sun-rise it was commonly between fifty and fifty-four, and at nine in the evening it generally fluctuated from sixty-two to sixty-six degrees. Fifty-one observations, from the 17th to the 25th March, gave an average of sixty-seven degrees. The seasons are nearly the same with those in Upper Hindustan. The rains commence a little earlier, and set in from the south-east quarter; they are generally very violent, and break out towards the middle of October. The mountain-torrents rush down in consequence with great impetuosity, overflowing their banks, and spreading over all the adjacent country. By these violent inundations, the plain is cut into numerous and deep ravines. The temperature varies necessarily with the elevation of the ground; so that by ascending the adjacent mountains, the heat of Bengal may in the course of a few days be exchanged for the cold of Russia.

Produce. The produce also varies along with the climate. In some parts rattans and bamboos, both of enormous dimensions, are seen, and others produce only oaks and pines. In several parts the pine-apple and sugar-cane ripen, whilst others yield only barley, millet, and similar grains. The mulberry grows luxuriantly all over the hills; and they cut its young and tender shoots annually, whilst full of leaves, and, having dried them, stack them for fodder, which is said to be both nutritious and agreeable to the animals. In this comparatively cold and elevated climate, the periodical rains are not favourable for the ripening of fruits, which everywhere abound, but never come to perfection, the heat of the climate not being sufficient to bring them to maturity before the approach of the rains. Peaches grow wild on every hill; but one side of them is rotted by the damp, whilst the other side is green; and the grapes, which grow without shelter from the rains, are always bad. Kirkpatrick, however, from the spontaneous productions which he saw on the spot, namely, the peach, the raspberry, the walnut, the mulberry, and others, thought that all the fruits and esculent vegetables of England might with proper attention be successfully raised in the mountainous valleys of Nepaul. In the warmer valleys, the pine-apple is uncommonly fine; as also the orange, which ripens in winter. The abundant rains, if they spoil the fruits, are, however, very favourable to the produce of grain; and wherever the land can be levelled into terraces, however narrow, it is well adapted for transplanted rice, which ripens after the rains have ceased. The least rocky faces of the hills are generally cut into these terraces, which are seen everywhere rising above each other. This operation produces numerous strips of level ground, more or less narrow, according to the steepness of the hills. Great labour and care are bestowed upon this operation, and it is often necessary to build a retaining wall to support the edge of the small strip of ground. Much attention is also paid to the levelling of its surface, to fit it for irrigation, as every rivulet is first conducted by drains to the higher cultivated spots, and then, after saturating them, to the lower range of fields. In some parts the same land gives a winter crop of wheat and barley. Where the land is too steep for terraces, it is generally cultivated after fallow with the hoe, and produces rice sown broadcast, maize, cotton, three kinds of pulse, a kind of mustard, manjeet or Indian madder, wheat, barley, and sugar-cane. Tobacco is an article of general cultivation in these hills, and it is considered as of a fine quality. It is exported in considerable quantities both to the plains and to Bootan. One of the great staples of agriculture in these mountainous countries is a large species of cardamom; and ginger is likewise a valuable production in the country between Nepaul Proper and the Cali, though rice is still the main dependence of the farmer. Various dry rices are cultivated in Nepaul, under the general name of ghya, some of which, so far from needing hot weather to bring them to maturity, are actually raised in situations very much exposed to falls of snow; whilst others do not require, as in Bengal, to be flooded, but flourish in the driest and loftiest spots. There are also amongst the spontaneous productions of this fertile soil several edible roots and herbs, which form a considerable part of the sustenance of the poorer inhabitants. Of these there are a species of yam, and a kind of wild asparagus, as well as various other plants well deserving the attention of travellers. There are also medicinal plants, and a rich variety of dyeing drugs procured from bitter or aromatic woods, which grow naturally in the country, and which are held in great estimation. The jeea is a very curious plant, from the expressed leaves of which is produced a juice called cherris, which is a potent narcotic, and possesses very valuable qualities, burning with a flame as bright as that of the purest resin. Its leaves are fabricated into a species of hemp, from which the Newars manufacture some coarse linen, and likewise a very strong kind of sackcloth. Though the soil seems well adapted to the growth of kitchen vegetables, yet the inhabitants are either too indolent or unskilful to raise them. The only kitchen vegetables which Colonel Kirkpatrick met with were cabbages and pease of the worst kind. They have the Thibet turnip, but cannot raise it, any more than the potato, without renewing the seed annually. Amongst these mountains are found the nettle, wild wormwood, raspberries, and mulberries; also a curious shrub called khaksi, the leaf of which answers the purpose of emery or sand-paper, giving a fine polish to the harder woods.

Anim[als]. The mountain pasture, though not so good as that in the low country, yet supports numerous flocks of sheep, which migrate with the seasons, in winter to the lower valleys, and in summer to the alpine regions, where they feed upon the herbage of those extensive tracts which lie in the neighbourhood of perpetual snow. The sheep in these altitudes are of considerable size, and have fine wool; the larger are the same as in the lower countries, but are not numerous.

Nepaul. Buffaloes are not reared by the natives, neither are hogs nor goats, though the country is admirably adapted for both. Horses are brought from Thibet, as none are bred south of the Himalaya; also the large ox of Thibet, or the *bos grunniens*, described by Turner, the beautiful tail of which forms one of the exports from Nepaul; and the goat which produces the shawl wool. The kustoora or musk-deer is a native of Lower Thibet, though it is not very abundant anywhere. It is usually caught by means of a snare made of a particular kind of mountain bamboo. It is difficult to obtain the musk pure, even at Catmandoo; and Colonel Kirkpatrick mentions, that it is even usual to adulterate it whilst it is yet in the bag on the body of the animal. In the great forest which skirts the Nepaul territories throughout their whole extent, from Serinagur to the Teesta, wild animals abound. Elephants are found here in great numbers, and are a source of revenue to the Nepaul government. About 200 or 300 of these animals are caught annually; but most of them being very young, and not being above seven feet and a half in height, they are not of great value. They are extremely mischievous, and two or three of them sometimes take possession of the road, and obstruct the progress of travellers for a considerable time. A large herd of them assaulted the camp of the Nepaul deputies when they were on their way to Patna, and were with great difficulty driven away. They sometimes issue from the forest in droves, and overrun the cultivated country on its borders, penetrating sometimes a considerable space within the company's territories. The rhinoceros, the tiger, the leopard, and other ferocious animals, find shelter in the depths of the forests. The animal known in Bengal by the name of the Nepaul dog is brought from Upper and Lower Thibet, of which it is a native. It is a fierce, surly creature, about the size of an English bull-dog, and covered with thick long hair. Several very fine birds are found in these mountainous countries, as the manal (*meleagris satyra*), and the damphya (*phasianus impeyanus*). They are a species of pheasants, the damphya being of the golden, and the manal or moonal of the spotted sort. They are both extremely beautiful birds. The chakoor is well known to the Europeans of India under the name of the fire-eater. It is a species of partridge, and derives its name from its reputed power of swallowing fire. The fact is, that in the breeding season this bird is remarkably fond of red pepper, after eating two or three capsules of which, it will bite at a red coal if presented to it. The khaledge is met with in the thickets which overrun the gorges of the mountains near Noakote. The sarus, wild goose, wild duck, and several others of the feathered species common to Bengal and the rest of the countries to the southward of Nepaul, are occasionally seen in this and the adjacent valleys; where, however, they merely appear as birds of passage, making Nepaul only a stage in their flight from Hindustan to Thibet.

Minerals. The stones and ores collected in the country indicate the existence of a variety of minerals in the mountains of Nepaul, such as iron, lead, copper, &c. It was formerly a prevalent idea amongst the Hindus, from whom it was received by the British, that the country contained mines of gold. The only foundation for this notion appears to be, that in the course of commerce the gold of Thibet passed into Bengal and Bahar through Nepaul; or that a few grains of gold were occasionally collected in the sands of the rivers, or found in the consecrated pebbles of Gunduck; or sometimes that specimens of gold ore have been sent to the governor-general by way of presents or curiosities. Other accounts of gold mines may also be referred to the circumstance of scanty particles of gold being found in the beds of torrents from the mountains. With regard to silver, it is said that some veins of it have been discovered to the westward of Noakote. But Kirkpatrick, in his account of Nepaul, suspects that it has no better foundation than that silver has lately been found in certain ores which were very rich in lead; whilst others appeared to be a species of galena, well worth the working for the sake of the silver which they contained. Several attempts had been made to extract the silver, but by such an unskilful process, that most part of the baser metal was sacrificed, in consequence of which the return scarcely repaid the expense. The copper is found quite near the surface of the earth, the ore being dug from trenches open above, so that the work is entirely interrupted by the rainy season. Those ores are found in several varieties, and are said to be rich and of an excellent kind. The mine is shared amongst certain families along with the rajah, who, there is every reason to believe, claims the lion's share, and, as in all other parts of Hindustan, leaves the workmen a bare subsistence. Oude was formerly supplied with copper from Nepaul; but of late years it has been superseded by European copper, owing to the difficulties and expense of transferring it to the market through a mountainous country without navigable rivers. The iron ore is also found near the surface, and is not surpassed in excellence by that of any other country. Sulphur is likewise abundant, and procured in great quantities. There is no good authority for believing that either the ores of antimony or mercury are found in the territories of Nepaul; but the western parts abound in arsenic and pyrites, though these sulphureous ores are no longer worked, on account of the deleterious effects occasioned by the operation. Stone is found in abundance and variety, particularly jasper and marble; but the houses are universally built of brick, because the use of stone, though abounding everywhere, is prevented by the expense of carriage in a country where the roads do not admit of wheel-carriages, and where there is no navigation. There is said to be a considerable mass of rock crystal near Ghoorkha, and limestone as well as slate abounds everywhere; yet there are no limekilns in the country, the only cement employed being mud, which, the natives pretend, answers better in their humid climate than mortar.

Mountains. The alpine region belonging to Nepaul is about the same breadth of thirty or forty miles from north to south. Scattered peaks are here seen covered with perpetual snow, until, in advancing to the boundaries of Thibet, everlasting winter reigns. This inhospitable region consists chiefly of immense rocks rising into sharp peaks and tremendous precipices, covered with snow, and almost constantly involved in clouds. Some of these mountains are estimated to rise 19,960 feet above the valley of Nepaul. The rains here are periodical, as in the plains of Hindustan, and fall in the hottest season of the year. The snowy ridge of the Himalaya Mountains, though it has a winding course, has few interruptions, and is in most places impassable. Several rivers which take their rise in Thibet make their way through the mountainous ridges, but by such narrow chasms, and amidst such enormous precipices, that these openings afford no practicable communication between the mountains and the plains. In the mountain passes no sort of baggage or merchandise is transportable, except on the shoulders of hill porters. The price of this carriage is regulated by the government.

Population. The numerous valleys which are interspersed throughout the mountains of Nepaul are inhabited by a variety of mixed races. The aboriginal inhabitants appear, from their physiognomy, to have been of Tartar or of Chinese origin, and to have had no resemblance to the Hindus either in features, religion, or manners. Before their arrival they had no idea of caste. The period when these mountainous regions were first invaded by the Hindus is uncertain; but, according to the most authentic traditions, it is supposed to have taken place about the fourteenth century. The Hindus who now inhabit these mountains were about this

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period driven from their country by the invasion of the Mahommedan sovereign of Delhi, who made proposals to marry a daughter of the rajah of Chitore, celebrated for her beauty. This offer was refused, and the consequence was that his city was captured and destroyed; and, to avoid the hated yoke of the conqueror, great numbers of the inhabitants fled to the mountains. Many of the chiefs amongst the mountain tribes, accordingly, claim descent from these Chitore princes, although on doubtful grounds. There are a few rajpoots whose claims to a pure descent from the Chitore family are allowed; and the families of the mountain chiefs who have adopted the Hindu rules of purity, and some even who have neglected this, are now admitted to be rajpoots; whilst, on the other hand, the purity of the Chitore blood has been so often contaminated by alliances with the Tartar and Chinese races, that several of the Chitore family have acquired the Tartar countenance, and some of the mountain tribes, by intermarriages with pure rajpoots in a low station, have acquired the oval faces and high noses of that remarkable race. The original purity of the rajpoot blood having been thus lost by indiscriminate alliances, all the hill chiefs, whether their descent from the Chitore family be real or pretended, are now called rajpoots, and hold the principal offices, civil and military, of the petty states in which the country was subdivided, until Nepaul was subdued by the reigning family of the Ghoorkhas. In the eastern parts of the country the aboriginal tribes still remain; and, until the predominance of the Ghoorkhas, they enjoyed unmolested their customs and religion. But west of the Cali the case is different, almost all the inhabitants claiming a descent from the Hindu colony. They accordingly consist principally of the two superior classes of Hindus, or brahmins and chetrees, with their various subdivisions.

East of the Cali the tribes which possessed the country were chiefly, 1. Magars, who occupied the lower hills in the western parts, and were very soon converted to the brahmin doctrine of abstaining from beef. They are at present enlisted by the Ghoorkha sovereigns, and compose a great majority of their troops. 2. The Gurungs, a pastoral tribe, shift their abode between the mountains and the valleys with the summer and the winter. They still adhere to the lama priesthood and the Buddhist religion. They cultivate with the hoe, are diligent miners and traders, and employ the numerous flocks which they possess in conveying their goods to market. 3. The Jariyas form a numerous tribe, and inhabit the lower hilly region between the Cali and the Nepaul valley, and are now nearly all converted to the brahminical doctrines. 4. The Newars are an industrious people, following agriculture and commerce, and are more advanced in the mechanical arts than the mountain tribes. The greater part of them adhere to the tenets of the Buddhists: though they have adopted the distinctions of caste, they do not acknowledge the lamas, and have a priesthood of their own. The more fertile part of what is called Nepaul Proper was chiefly occupied by the Newars, a race addicted to agriculture and commerce, and far more advanced in the arts than any other of the mountain tribes. Their style of building, and most of their arts, appear to have been introduced from Thibet. All the Newars burn their dead; they eat buffaloes, sheep, goats, fowls, and ducks, and are addicted to the immoderate use of spirituous liquors. They live in towns or villages, in houses built of brick cemented with clay, and covered with tiles; these houses are three stories high, the ground-floor being allotted to the cattle and poultry, the second to the servants, and the third to the family of the owner. Their rooms are low, and have a mean and dirty appearance, and, besides, are infested with vermin, which, in addition to the filth, the offals of the shambles, and the blood of their sacrifices collected in the streets, give their towns an exceedingly offensive aspect to Europeans. The Newar women are never confined to the house. At the early age of eight years they are carried to a temple, and married, with the usual ceremonies of the Hindus, to a fruit called *ull*; and when they arrive at puberty they are betrothed to a man of the same caste, and the parents give a dower to the husband, or rather her paramour, their manners being extremely licentious. Like the women amongst the Nairs, they may in fact have as many husbands as they choose, being at liberty to divorce them as often as they please, and upon the slightest pretences. The Newars are peaceable, industrious, and even ingenious; much attached to the superstition which they profess, and now reconciled to the chains imposed on them by their Ghoorkha conquerors. Their occupations are chiefly those of agriculture; and they are, besides, almost exclusively employed in the arts and manufactures of the country. They are generally of the middle size, possessed of great corporeal strength, with broad shoulders and chest, very stout limbs, round and rather flat faces, small eyes, low and somewhat spreading noses, and open and cheerful countenances, with little or no resemblance, according to Kirkpatrick, to the Chinese countenance. The complexion of the women is somewhat between a sallow and a copper colour. 5. The Dhenwars and Mhanjees are the husbandmen and fishers of the western districts. 6. The Bhootias. Though some families of this race are planted in the lower lands, they occupy, generally speaking, such parts of the mountainous country as are included in the Nepaul territories. They shave their heads, and observe many idolatrous rites and customs. 7. The Bhanras are a sort of separatists from the Newars, and are supposed to amount to 5000. They observe many of the customs of the Bhootias. To the eastward some districts of the Nepaul dominions are inhabited by tribes, such as the Limbooas, Nuggerkootees, and others, of whom little more is known than the names.

With regard to the number of inhabitants within the bounds of Nepaul, we have no data to form any thing like an accurate estimate. The wild and rugged nature of the country gives no ground to suppose that the population is considerable. It is in the valleys that the population is collected; and these, says Kirkpatrick, with the exception of Nepaul and two or three others, are little better than mountainous cavities. Even the Terriani, or low belt of land which runs along the southern frontier, is but indifferently peopled, the villages being, according to the traveller already mentioned, very thinly scattered, and mean both in their appearance and in their size. The Nepaulese themselves give the most exaggerated account of their numbers. They reckon their population by houses; and to Patan, their largest town, they assign 24,000 houses, to Bhatgong 22,000, and to Catmandoo 18,000. This would give a population of 640,000. There are, besides, many large villages and towns scattered around Kirteepoor, containing 12,000 houses; Theamee, Buneba, Pharping, Punonlee, Dhulkill, Chappagang, all containing from 6000 to 7000 houses; and, besides these, there are reckoned between twenty and thirty smaller, of from 1000 to 4000 houses, all within the valley of Nepaul. But this gives a population that sets probability at defiance, and is considered, both by Frazer and Kirkpatrick, as a glaring fallacy. A loose estimate of the latter traveller lowers the population of Nepaul to half a million of souls.

State of property.

The lands are held by various tenures. Those constituting crown-lands, or the rajah's immediate estates, are chiefly situated in the Ghoorkha territory, though there is hardly any portion of the Ghoorkha conquests in which the prince has not appropriated land to his own use. Some of these lands are cultivated by husbandmen, who receive a share of the produce; others are tilled by the neighbouring husbandmen, who are obliged to dedicate a certain

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Military force. The whole population of Nepaul are liable to military service in times of public danger, though they are not regularly trained to arms. But there is a standing army dispersed over the country, besides a large force always in the capital, amounting to 30,000 or 35,000 troops. These troops are regularly trained, disciplined, and officered after the manner of European troops; and they likewise affect the European exercise, dress, and arms. The regular force of Nepaul has so long been accustomed to active service and to constant victory, that they have acquired all the qualities of veteran soldiers, a fearlessness of danger, and a contempt of any foe opposed to them. "They have," says Frazer, "much of the true and high spirit of a soldier, that setting of life at nought in comparison of the performance of duty, and that high sense of honour which forms his most attractive ornament, and raises his character to the highest." These qualities were frequently displayed in the course of the campaign with the British, against whose overwhelming attacks fortresses were defended with a determined bravery, and a patient endurance of famine and misery, that were truly exemplary. And when they at length surrendered a fort which was no longer tenable, they deplored their hard fate, called themselves wretched men that ought rather to have died, and refused to return to their native country; whilst the courtesy they showed to the British, and the reciprocal good offices received and returned, resembled more the generous spirit of European warfare, than the cruel practices of the East. The expenses of the military establishment are mostly defrayed by assignments of land, though in some instances the soldier receives his pay from the treasury, and occasionally from the public granary; others are paid partly in money, and partly in land; but the most usual mode, and the one most agreeable to the troops, is by putting them in possession of tracts of land, on which they generally settle their families, whom they can maintain better in this manner than by any pecuniary stipend. There seems no fixed rate of reward for different ranks, a good deal depending on the interest of the parties, and other incidental circumstances. One of the captains of the rajah's company of guards informed Colonel Kirkpatrick, that the lands which he held yielded him 180 rupees a year, and that he received an additional sum in money of 280 rupees; but added, that he was better off when he belonged to a private company. It may be added, that government evinces great consideration for its military and public servants, being particularly indulgent to their widows, orphans, and other destitute branches of their families. The soldiers are in general stout, thick, and well-built men. They are very brave, and prefer close fighting, giving an onset with a loud shout. During the war with the British they attacked with great valour and impetuosity, advancing to the very muzzles of the cannon. They understand the use of the sabre; and each man wears, besides, a "cookree," or long crooked heavy knife, which may be used in war, but is also of great use in all common operations where a knife or hatchet is required. The soldiers also carry a long sort of matchlocks or muskets. The officers, besides the sword and shield and "cookree," carry bows and arrows, which they use very dexterously. The sword which they use has the edge curved inwards like a reaping hook, but far more straight, and very heavy, particularly at the point, where it is very broad, and ends abruptly square. A few small guns are used; but they are confined to the walls of forts, and never carried into the field.

Government. The government of Nepaul is essentially a despotism, and is good or bad according to the character or temporary views of the reigning prince. It is no doubt slightly ameliorated by the authority of immemorial customs, and the influence of religion, which no prince, however despotic, can safely disregard; as well as by the occasional opposition of the aristocracy or chiefs. But the great body of the people derive little benefit from the struggle for power between the prince and his nobles. They seem to possess no civil rights, and are at the mercy of their rulers for whatever treatment the latter think proper to give them. It was observed by Kirkpatrick, in the course of his journey into the country, that the carriers were pressed, without ceremony, into the service of government, and compelled to work without any promise of pay; and in the war with the British, a detachment of troops, because they yielded a post to the enemy which they could no longer hold, were punished with extraordinary cruelty, being mutilated in their faces in the most shocking manner. In Europe the progress of improvement has modified the rigour of the most absolute governments; but in Nepaul, as in all the Asiatic states, despotism grows up to the most frightful maturity in the congenial soil of ignorance; and although the arbitrary will of the prince may be opposed by the force of circumstances, yet there is no permanent security for life and property, such as is derived from the authority of fixed laws. The administration of public affairs is carried on by various officers. The first of these is the choutra or prime minister to the rajah, to whom he is invariably akin. His business is to receive and examine all written and verbal communications regarding public business, and to act as a sort of comptroller-general over the inferior departments of administration. He holds his office during the pleasure of the prince, to whom he submits all his reports on matters of state; and the former, if he see proper, refers them for further investigation to a court of inspection appointed for the purpose. He is paid by a commission or fine on every rice plantation, with the exception of those of the Thurgars or nobles and the military. Secondly, the kajees are four commissaries who superintend all civil and military affairs, and are employed in the collection of the revenue, and in the management of the Jaghire lands. They are paid by a tax of one rupee on all taxable lands. Thirdly, the sirdars command the armies of the state, and likewise participate in the management of civil business. Fourthly, the kurdars act as secretaries, preparing all communications from the rajah to foreign powers, or to the officers of state. Fifthly, the kupperdar and the kuzanchee have the charge, the one of the

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rajah's private wardrobe, jewels, and kitchen; and the other of the public wardrobe, from which honorary dresses are issued. All these officers are paid by a moderate duty upon all taxable lands. Sixthly, the ticksali or superintendent of the mint is paid by a commission on the import duties from Thibet, and on a tax payable by all natives of Nepaul who return to their country from Lehassa, Diggercheh, or other parts of Thibet. This tax is exacted with a good deal of rigour. Seventhly, the dhurmaudhikar is the chief criminal judge, who commissions all the inferior judges, excepting those who officiate in the farmed districts. The fees in this department are very great; and as most crimes are punishable by fine, the penalties constitute a large source of emolument, which does not by any means favour the pure administration of justice. Civil questions regarding property are decided by another tribunal, the members of which are usually brahmins. Over this court the criminal judge sometimes presides. Intricate questions are occasionally referred to a superstitious ordeal, in which chance decides; and this barbarous process is a sure index to the manners of the people, and to the low state of their civil institutions. There is, besides, a superintendent of the police, a minister who is employed in complimentary embassies to foreign powers, or in carrying orders to public officers. The soubahs are governors of districts, or farmers, and government collectors, acting as officers of revenue, of justice, and of police; and the omrahs are commanders of military posts.

Revenue.

The public revenue is derived from land-rents, customs, fines of various sorts, and from mines. Annual presents are made by the soubahs, and by every one who approaches the court; and a sort of arbitrary income-tax is besides levied from all ranks, even the sacred order, who possess free lands, not being exempted. An officer is often employed for the express purpose of collecting this tax, which is rated according to the exigencies of the state, and which mounts up in many districts to more than the regular revenue. According to Colonel Kirkpatrick, who visited the country in 1792, and who derived his information from good authority, the revenue actually remitted to Catmandoo never exceeded thirty lacs of rupees (L.35,000), but it sometimes fell to twenty-five lacs. The subsequent conquests by the Ghoorkha sovereigns were not productive of a great increase of income; and the reduction of territory by the late war would of course occasion a corresponding diminution. The export duties, and the profits on the sale of elephants, bring in from three to four lacs of revenue. The import duties levied on the trade from Thibet, included under the mint, as the returns consist chiefly in silver bullion, amount to about seven or eight lacs. The duties on salt, the profits on saltpetre, which appears to be a monopoly, on copper and iron mines, and the produce of the land-tax, may be estimated at from fifteen to eighteen lacs. Formerly the inhabitants of Thibet were supplied with a silver currency from the mint of Nepaul, on which the treasury gained a profit of a lac of rupees.

Trade.

The trade of Nepaul is by no means so extensive as it might be if it were conducted under proper regulations; being shackled by monopolies for the benefit of government, or of a few favoured merchants, who labour to preserve their privileges by the most invidious and corrupt means in their power, and by other injudicious restraints. But, at the same time, the surplus produce of so poor a country could scarcely afford the basis of an extensive trade; and it was accordingly rather the medium of communication between other countries, than remarkable for the extent of its own commerce. Formerly merchants from Cashmere carried their manufactures to Kutti and other towns in Thibet, and received in return the wool produced in these countries from the shawl goat. Such portions of these manufactures as are not used in Thibet were exported by the way of Teshoo Loomboo and Lassa, to Siling or Sining on the frontiers of China, and partly sent to Catmandoo by way of Patna. The principal goods imported in return to answer the demand of Cashmere and Nepaul were teas and silks; and from Patna, it is said, they exported otters' skins to a great amount, procured from the neighbourhood of Dacca. The articles imported into Nepaul from Thibet are coarse woollen cloths, paper, horses, sheep, shawl goats, chowry bullocks, chowries or cow-tails, musk-deer, dogs, falcons, pheasants, salt, sal-ammoniac, hurtal or yellow arsenic, borax, quicksilver from China, gold in grains and in small lumps, antimony, rugs or coarse blankets, munjheet or Indian madder, cherris or extract of hemp, besides various medicinal drugs and preserved fruits, such as almonds, walnuts, raisins, dates. Of these articles, the greater part of the musk, chowries, hurtal, borax, and bullion still find their way to Patna; whence in return are sent north, buffaloes, goats, broad cloth, cutlery, glass ware, and other European commodities, Indian cotton manufactures, mother of pearl, pearls, coral, beads, spices, pepper, betel nut and leaf, camphor, tobacco, tin, lead, zinc, and phajoo, the red powder thrown by the Hindus during the hooly. Besides these articles, utensils in wrought copper, brass, bell-metal, and iron, are sold to the merchants of Thibet. The borax and salt are said to be brought from a lake which is situated nearly north from Catmandoo, about fifteen days' journey beyond the Brahmaputra. The carriers of these articles are a large kind of sheep, with four horns, which appear to be the common beasts of burden in all countries towards the sources of the Indus, Ganges, and Brahmaputra. Formerly the lamas of Lassa and Teshoo Loomboo sent a large sum in bullion to be coined at the mint of Catmandoo, on which an allowance of four per cent. was made for the coinage. But the rapacity of the rajah induced him to alloy the rupee to the amount of eight per cent., which had the effect of putting an entire stop to this source of revenue.

Manufactures.

The Newars are almost the only artisans in Nepaul; and they appear to be acquainted with and to exercise most of the handicraft occupations of their neighbours. The Newar women of all ranks, as well as the men, of the hill-tribe of Mugar, weave two sorts of cotton cloth, partly for home use and partly for exportation. These cloths are the dresses of the middling and lower classes, although woollens would be much better fitted for the cold climate of a Nepaul winter. Those, accordingly, who are not very poor, wear woollen blankets, which are manufactured by the Bhooteas, who wear nothing else. The dress of the higher ranks is not manufactured at home, but is imported, consisting of Chinese silks, shawls, low country muslins, and calicoes. European broad cloth is worn by the military alone. They work very well in iron, copper, brass, &c.; and in Lalita, Patan, and Bhatgong, there are considerable manufactories of these articles, and also of a species of bell-metal. One bell which was manufactured at that place measured five feet in diameter. The Thibet bells are superior to those of Nepaul, though a great many bell-metal vessels are made by the Newars, and exported to Thibet, along with those of brass and copper. They are likewise particularly ingenious in carpentry; but it is remarkable that they never use a saw, dividing their wood, of whatever size, by a chisel and mallet. They are skilful in gilding; and they manufacture at Bhatgong, from the bark of a shrub, a very strong paper, remarkably well suited for packages. They distil spirits from rice and other grains, and also prepare a fermented liquor from wheat, munooa, rice, &c. which they call jhaur. It is made somewhat in the manner of malt liquors, but is more intoxicating. The Newar peasants use it in the same manner, and consider it as necessary for their comfort as the labouring people of Britain do porter.

Nepaul. History.

The early history of Nepaul, like that of most of the eastern countries, is buried under a mass of fable. The inhabitants exhibit a list of princes for several thousand years back, which is given in Colonel Kirkpatrick's work, but without any evidence of their authenticity. It is doubtful whether such persons ever existed. We know, however, that Nepaul was the scene of important revolutions, though it never was subjected to the Delhi emperors, or to any of the other great Asiatic powers. It is said to have been completely subdued in A. D. 1323, by Hurr Singh, one of the princes of Oude, who was driven out of his own possessions by the Patans. But from that period there exists no accurate information respecting the dynasties which ruled during the interval, or the race of princes who governed Nepaul at the time of the Ghoorkha conquest. Runjeet Mull was the last of the Surya Bansi race, or children of the sun, that reigned in Nepaul. He formed an alliance with Purthi Nirain, which ended in the loss of his dominions, of which he was stript by his ally in the Newar year 890 or 888, corresponding to A. D. 1768. He possessed great courage and insatiable ambition, and was indebted for his success in war to his introduction of firelocks and European discipline amongst his troops. It was in his reign that Captain Kinloch, with a British force, endeavoured to penetrate into Nepaul. But, from the sickness of the troops, and the difficulty of the country, the enterprise was abandoned. Purthi Nirain died about three years after the final conquest of Nepaul, that is, in the year 1771. He left two sons, Singh Pertaub and Behadur Shah, the former of whom succeeded to the throne, and, conceiving a jealousy of his brother, threw him into prison, whence he was with difficulty released by the interference of one of the spiritual guides of the Ghoorkha family, on condition that he should live in exile. Singh Pertaub, after having extended his father's conquests, died in 1775, leaving one son, who was an infant. Behadur Shah, on the death of his brother, returned from his exile to Catmandoo, and, having placed his nephew on the throne, assumed the office of regent. But the mother of the infant prince, Rajender Letchemi, contrived to supplant Behadur Shah in his office, and even to secure the person of her rival. Through the mediation, however, of one of the priests, an accommodation took place, and Behadur Shah was thus enabled to seize and confine the ranee in his turn. Neglecting, however, to conciliate the chief men of the state, he was again driven into banishment, from which he did not return till the death of the princess, when he re-assumed the regency without opposition. In the course of his administration, Palpa, and many other petty states to the westward, Bhote to the north, and Sikkim to the east, were compelled to submit to the rule of the Ghoorkhas.

Towards the close of the administration of Mr Hastings in India the Ghoorkha sovereigns were involved in hostilities with Thibet, and finally with China. The Teshoo Lama of Thibet having proceeded to Pekin, died soon after his arrival in that city. His brother, Sumhur Lama, taking advantage of his absence, fled from Lassa to the rajah of Nepaul, carrying along with him a considerable quantity of treasure; and he made such representations to the Nepaul government that their avarice was inflamed, and having marched a body of troops to Lassa, they extorted from the lama a tribute of three lacs of rupees. In 1790 they detached to Teshoo Loomboo, the residence of another sacred lama, a second body of troops, amounting to 7000 men, who pillaged the place and the sacred temples, and succeeded in carrying off a large booty, though closely pursued by a Chinese army, and though, from the severity of the weather, they lost 2000 men in their retreat. The emperor of China, as the terrestrial superior of the lamas, and their worshipper and protector, incensed by these unprovoked aggressions, despatched an army of 70,000 men against the Nepaulese, who were overthrown in repeated battles; and the Chinese army advanced to Noakote, within twenty-six miles of Catmandoo, and sixty of the British territory of Bengal. A peace was at last concluded, though on terms ignominious to the Nepaulese, who were compelled to become tributaries to the Chinese, and to refund the spoil which they had taken from the Thibet lamas. It does not appear, however, that this tribute was ever exacted. It was about this period that Lord Cornwallis attempted to conclude a treaty of commerce with the Nepaulese; but every proposition of this nature was frustrated by their extreme jealousy.

The queen-regent died in 1786, when the care of the young rajah devolved entirely on his uncle Bahadur Shah, who was accused of having, from disgraceful motives, encouraged the rajah in his debaucheries, in hopes of bringing him into contempt, and of thus securing to himself the reins of authority. In this expectation, however, he was deceived, as the rajah, in 1795, when he had entered into his twentieth year, suddenly announced to his uncle that he had now resolved to assume the reins of government, and being supported by a large proportion of the nobles, Bahadur Shah, making a virtue of necessity, forbore all resistance, and received in return assurances of the most distinguished favour. The young rajah rendered himself extremely popular during the first year of his reign. But this fair prospect was speedily overcast, and the youth plunged into all the excesses of the most furious despotism and cruelty. His first act was to arrest his uncle, and, loading him with chains, to throw him into prison, where he was starved to death. He daily tortured and mutilated his subjects, and beheld their sufferings with savage joy. In his outrages he made no distinction of age or sex. Women of all castes, even those belonging to the sacred orders, were seized, and subjected to abuse from the vilest characters. In 1797, he had a son by a brahmin widow, who being taken seriously ill next year, and finding her end approaching, reminded the rajah of the prediction of astrologers, that he would never complete his twenty-fourth year, and entreated that he would provide for the unprotected orphan they were about to leave. The rajah, relying implicitly on the superstitious prophecy, immediately, and in the most solemn manner, before all the chiefs, abdicated the throne in favour of his son, though illegitimate, and an administration was then appointed, over which one of his ranees or queens was appointed to preside. The abdicated monarch now devoted his whole time to attendance on his favourite widow, who, notwithstanding all his attention, and rich offerings at the different temples, soon afterwards expired. In his affliction he became quite frantic, and perpetrated atrocities, the bare mention of which causes the Nepaulese still to shudder, and which are too shocking to be narrated. Amongst various enormities, he directed the sacred temple of Bahvani to be demolished, and the golden idol, which was a venerated object of worship, to be ground to dust; and when the soldiers to whom he had issued the orders demurred at such an act of sacrilege, he commanded boiling oil to be poured on their naked bodies. Nor did any one escape his rage. Neither rank nor caste afforded any protection from his violence. Even the first members of the government were scourged without mercy, and otherwise tortured. A confederacy was at last formed against the tyrant, who finding himself abandoned, absconded during the night, and fled to Benares, which he reached in May 1800.

A close connection with Nepaul had always been a favourite object with the British rulers of India, and the flight of the rajah to Benares appeared to present a fair opportunity for bringing it about. A treaty of alliance was accordingly concluded between the two states, by Captain W. D. Knox, who was appointed ambassador, Nepaul. and who proceeded to Catmandoo for the purpose in 1802. The terms of the treaty were considered as favourable to the British interests; the Nepaulese being anxious to secure the influence of such powerful neighbours against the faction of the abdicated rajah, who still contended for his restoration. But whatever advantages were attained by this treaty, were ultimately rendered nugatory by the jealous opposition of the subordinate officers amongst the Nepaulese, who were probably instigated by their chiefs, the latter being entirely unable to fulfil the obligations which they had entered into.

The residency at Catmandoo was accordingly withdrawn in the year 1804. About this time the abdicated monarch, Run-Bahadur, by the able management of his queen, whom he had always ill treated, was restored to his former authority. But as he continued to rule with his former barbarity, his reign was of short duration; in 1805 a conspiracy was formed against him, which terminated in his assassination. His death was succeeded by the most violent conflicts between the adverse parties in the state, and did not terminate until nearly the whole of the nobles at Catmandoo had perished. The surviving adherents of the late rajah having at length secured the person of his son, seized on the reins of government, putting to death such of the opposite party as still remained.

But during all these intestine commotions, it is remarkable that the Nepaulese still extended their conquests on every side. To the west of Catmandoo, and towards the Sutlege, the hill-chiefs were distracted by mutual jealousies, and by no means in a condition to form a league for their mutual defence. They were accordingly subdued one after another by the armies of the Ghoorkhas, who very soon made themselves masters, without the aid of artillery, of every hill-fort, from the Ganges to the Sutlege. When their movements first attracted the notice of the British government, their chief was vigorously prosecuting the conquests of these states; and as he advanced westward, he erected strong forts and stockades at convenient positions, namely, Almorah, Serinagur, and Malowa. The Sikh frontier was also guarded by a strong line of fortified posts; and thus the consolidation of the Ghoorkha empire proceeded with a slow but sure progress. The extensive tract which lies between Catmandoo and the Sutlege was held in firm subjection by a strong military force, whilst to the east the Sikkim rajah was deprived of half his territories, and compelled to pay a tribute for the remainder. To the north the progress of conquest was restrained by the Chinese power, with which the Ghoorkha chiefs had already found themselves unable to cope, and also by a lofty range of barren mountains. But the fertile and low situated plains of the south presented a more alluring prospect, and greater probabilities of success in a contest with a new and untried power. The consequence was a series of encroachments along the whole northern frontier of the British possessions, especially in the district of Gorruckpoor and Sarun. The British remonstrated against these proceedings, and an investigation into the respective claims of the two powers was commenced by commissioners jointly chosen, the result of which being entirely favourable to the British, a detachment of regulars was ordered to take possession of the debateable ground. But these being withdrawn during the rainy season, the chief police station upon the frontier was attacked by large bodies of Nepaulese, and the officers were compelled to fly, with a loss of eighteen killed and six wounded. Shortly afterwards a second attack was made on another police station, and several persons were killed, after which the whole body was withdrawn; and, in 1814, the war commenced. A brief account of the operations of this war will be found under the article HINDUSTAN; and it is only necessary here to state generally, that the invasion of the Nepaulese dominions was commenced on the western frontier, beyond the Jumna and near the Sutlege, the country there being considered as of easier access than the mountainous barrier which bounds the Nepaulese dominions on the side of Bengal. But the British troops, in attempting to storm the stockades and hill-forts, were repeatedly driven back with severe loss, and suffered reverses to which they had been wholly unused in the wars of India. Here it was that the brave General Gillespie was slain, whilst he was encouraging his troops, who had been repulsed, to renew the attack. In 1815, Sir David Ochterlony assumed the chief command, and by a series of skilful operations, in which he dislodged the Ghoorkha troops from the fortified heights of Malowa, and ultimately so hemmed in their renowned commander Ameer Singh, and his son, that they were forced to sign a capitulation, by which they agreed, on being permitted to retreat with their remaining troops, to abandon the whole territory west of the Cali branch of the Goggra. In Kumaon also the British troops succeeded in driving the enemy before them; and, in consequence of these successes, a definitive treaty of peace was signed on the 28th of November 1815. But the signature of the rajah being withheld, it was determined to renew the war, and to strike a decisive blow directly at the capital of the country. Preparations for this arduous enterprise were made on a great scale, a force being assembled at Sarun amounting to about 13,000 men, of whom 3000 were Europeans, besides a large body of irregulars, amounting in all to above 46,000 troops. This formidable force took the field in the end of January 1816, and advanced from the Bettiah district directly on Catmandoo. The greatest difficulties were encountered, from the ruggedness of the country, in marching along the dry beds of torrents, through ravines, and in the face of precipices. But all these obstacles were overcome by the patience of the troops, and the consummate skill and science of their commander. The Ghoorkhas made a brave resistance, but they were overthrown in several severe encounters; and the British force had now approached within three days' march of their capital, Catmandoo. Deeming all further resistance vain, an ambassador was sent to the British head-quarters, to sue for peace; and the unratified treaty of the year 1815 was accordingly duly signed. By this treaty the Nepaulese renounced all claims to the territory in dispute. They also ceded all the conquests which they had made to the west of the Cali branch of the Goggra, and which, with the exception of Kumaon, the Deyrah Doon, and some other portions of territory annexed to the British dominions, were restored to the families of the chiefs who had reigned there prior to the Ghoorkha invasion, and who were now to rule as vassals of the British; it being understood, however, that the latter were not to interfere in the internal administration, but were merely to act as arbiters between rival chiefs.

In the course of this contest with the British, the Nepaulese had earnestly entreated the aid of the Chinese against the Europeans, whom their ambassadors represented as desirous of acquiring Nepaul merely to serve as an intervening point in their progress to China. Their application being transmitted by the grand lama to Pekin, an answer was received, in which the emperor expressed his conviction that the Ghoorkhas had themselves been the cause of the war by their unjust encroachments, and declined all interference. After peace was concluded, the Chinese emperor expressed deep offence against the rulers of Nepaul, who, being merely tributaries, had presumed to make war or peace with the British, without the sanction of their superior; and, to back those lofty pretensions, an army of 15,000 men, commanded by five generals, and attended by Chinese functionaries of superior rank, usually stationed at Lassa, actually advanced towards the Nepaulese territories. At the request of the Nepaul ministers, the British consented to act as mediators. But in the mean time they themselves despatched to the Chinese camp agents, who having reached it early in September 1816, succeeded in bringing about the restoration of peace, and of all the ancient relations between the two powers. In 1816, Ameer Singh Thappa, one of the most distinguished Ghoorkha commanders, who had so gallantly disputed the field with Sir David Ochterlony, died, at the age of sixty-eight. To the last day of his life he was endeavouring, by negotiation, and by every art, to excite amongst the different states a spirit of hostility against the British, as the common enemies of Indian independence. Two of his widows devoted themselves to death along with him; one sacrificed herself on the spot, and the other was at the same time preparing for the fatal pile at the temple of Pushpoonath, within the valley of Catmandoo. In November 1816, the young rajah died of the small-pox, at the age of twenty-one years. One of his queens, and one of his concubines, together with five female attendants, devoted themselves to the funeral pile along with the corpse. He left one son, three years of age, named Rajindra Bickram Shah, who succeeded quietly to the throne, under the guardianship of the minister Bheem Singh Thappa; a very unusual circumstance in the annals of Nepaul. No interruption has occurred since this period to the peace happily concluded with the British; nor, according to the latest accounts, has the internal tranquillity of the country been disturbed.

NEPEAN Island, in the South Pacific Ocean, is about a quarter of a mile distant from Norfolk Island. The communication, however, is rendered difficult by the mountainous sea which runs between the two islands, and which, during the short period they have been occupied by British settlers, has occasioned numerous fatal accidents. It is uninhabited, and is employed as a place of transportation for refractory convicts, where they are employed in boiling salt.

NEPEAN Point, a rocky promontory on the north coast of New Holland, and the eastern point of entrance into Port Philip. Long. 144. 38. E. Lat. 38. 18. S.

NEPOMUK, a town of the Austrian kingdom of Bohemia, in the circle of Klattau, adjoining to which are some extensive iron-works and mines, on the hill called the Gruneburg, belonging to Prince Colloredo. It is a place highly venerated, from having given birth to John Nepomuk, in the year 1320. That person is reported to have been confessor to the queen, whose chastity was suspected by her spouse. He demanded of the confessor the revelation of what had passed in the confession; but Nepomuk refused to disclose it. For this he was bound hand and foot; and still refusing to discover the secrets, was in that condition thrown into the Moldau and drowned. He was afterwards, for this conduct, canonized by the pope, and included in the catalogue of martyrs. He thus became the tutelar saint of the Bohemian Catholics.

NEPOS, Cornelius, a Latin writer, who was the friend of Cicero, Atticus, and the poet Catullus, and flourished B. C. 40. It is uncertain where he was born, but Pliny (iii. 22, 2) calls him *Padi accola;* and his friendship with Catullus makes it not improbable that Hostilia, near Verona, where that poet was born, was also his birthplace. We possess no information respecting his private life; but many of his works are cited by later writers. 1. His Chronicles or Annals, probably in three books, of which the fragments do not enable us to decide whether they were confined to the history of Rome, or included that of all nations. Some have asserted that this was a mere translation of the work of Apollodorus on the same subject; but they have no sufficient grounds for so believing. 2. The *Exemplorum Libri,* of which the fifth book is cited by Aulus Gellius (vii. 18), and which seems to have been a work containing remarkable transactions selected from history; but this may have been only another title for his work. 3. The Lives of Illustrious Men, of which the sixteenth book is cited, and the lives we now possess no doubt formed a part. 4. The Lives of Historians (Nep. Dion. iii.), which included both Greek and Latin. It seems not unlikely that the biographical sketch still remaining of Atticus, and the longer one of Porcius Cato, which he mentions (Cato, iii.), belonged to this collection. 5. The Letters to Cicero, which must have been published, as some of them are quoted by Lactantius (Inst. iii. 15). It would appear that he had also made successful attempts in poetry (Plin. Ep. v. 3).

We possess a work under the name of Nepos, *Vitæ Excellentium Imperatorum,* which is not mentioned by any ancient writer under this title. It contains short biographical sketches of twenty commanders, mostly Greek; an essay, *De Regibus,* which is little else than the mere names of Greek and Persian kings; and the lives of Hamilcar and Hannibal. There are also two other biographical sketches of Atticus and Cato, which used to be separated from the rest, because they were not found in all the manuscripts, or, when found, were entitled *Ex libro Corn. Nepotis de Latinis Historicis,* whilst the others used to be considered as the work of a certain Æmilius Probus, whose name was found in all the manuscripts. The following unpoetical lines were found to precede them:

> Vade liber noster, fato meliore memento,
> Cum legat hæc dominus, *te sciat esse meum.*
> Si roget auctorem, paullatim detege nostrum
> Tunc domino nomen, *me sciet esse Probum.*

This Æmilius Probus was long considered as a contemporary of Nepos; but he is now generally believed to be the *præfectus prætorio* to whom Ausonius addresses his sixteenth epistle, and is supposed to have lived in the reign of Theodosius, A. D. 370. At first, however, this work appeared under the name of Probus, and was thus published 1471, and in the following editions till 1563. Gifanius in 1566 first directed the attention of the literary world to Nepos as the author; and subsequent investigation has nearly set the question at rest. Attempts have, however, been recently made by an Italian critic (in his *Saggio di un Esame critico per restituire ad Emilio Probo il libro De Vitis Excell. Imp. creduto communemente de Corn. Nepote,* Venez. 1818, et Kohen; and in *Considerazioni sul Saggio di un Esame del Sign. Rinck.* Mediol. 1819) to revive the old opinion; and he founds his belief on the authority of the manuscripts and of the poetical address or dedication, on the silence of ancient writers, to whom these lives seem to have been unknown, on several mistakes in history and chronology which appear in the work, and on the language, which he considers as unworthy of the golden age of Roman literature. (See this question treated fully by Bardili, in his preface to his edition, Stuttgard, 1820; and by Dähne, Lips. 1827.)

NEPTUNE, in pagan worship, the god of the sea, was the son of Saturn and Vesta or Ops, and the brother of Jupiter and Pluto. He assisted Jupiter in his expeditions, for which reason that god, when he attained the supreme power, assigned to him the sea and the islands as his empire. He was, however, expelled from heaven along with Apollo, for conspiring against Jupiter; and after this event both were employed by Laomedon, king of Phrygia, in building the walls of Troy; but that prince having dismissed Neptune without a reward, the latter in revenge sent a sea-monster to lay waste the country. He is said to have been the original inventor of horsemanship and chariot racing, on which account Mithridates king of Pontus threw chariots drawn by four horses into the sea in honour of this god, and the Romans had horse-races in the circus during his festival, when all other horses left working, and the mules were adorned with wreaths of flowers. In a contest with Minerva he produced a horse by striking the earth with his trident; and on another occasion, in a trial of skill with Minerva and Vulcan, he produced a bull, for which reason that animal was sacrificed to him. His favourite wife was Amphytrite, whom he long courted in vain, till sending a dolphin to intercede for him, he met with success, and the dolphin was rewarded by being placed amongst the stars. Besides Amphytrite, he had two other wives; one of whom was called Salasia, from the salt water, and the other Venilia, from the ebbing and flowing of the tides. He had likewise many concubines, by whom he had a great number of children. He is represented with black hair, and a garment of an azure or sea-green, holding his trident in his hand, seated in a large shell drawn by sea-horses, and attended by the sea-gods Palemon, Glaucus, and Phorcys, and the goddesses Thetis, Melita, and Panopæa, with a long train of tritons and sea-nymphs. This deity was known in Egypt by the name of *Canobus* or *Canopus*, and was worshipped as the *numen aquarum*, or spirit of the Nile.

NEPTUNE'S ISLES, a cluster of low islands situated on the south coast of New Holland, at the entrance into Spencer's Gulf.

NERAC, an arrondissement of the department of the Lot and Garonne, in France, 443 square miles in extent. It contains seven cantons, divided into ninety-two communes, and inhabited by 57,500 persons. The capital is the city of the same name, situated on a fruitful plain, through which the river Blaise runs. In a castle now in ruins the kings of Navarre held their court, and Henry IV. of France passed his youth in it. It contains 860 houses, with 5850 inhabitants, who make cotton goods, druggets, and serges, leather and glass, and domestic articles of copper ware; and carry on considerable trade in corn, wine, and other productions of the soil. Long. 0. 13. E. Lat. 44. 10. N.

NERBUDDAH, a large river of Hindustan, in the province of Gundwana, which, after a course of 750 miles, falls into the Gulf of Cambay. This river has its source at Omercuntuc, in the above province, close to that of the Soane. The Mahanuddy has also its source in the same mountain. A Hindu temple is found in the centre of the table-land at Omercuntuc; and here the Nerbuddah rises from a small well, and flows along in a smooth stream, until it is precipitated into the Mundlah. This is described as a great fall by the natives; and the river at the foot of the table-land expands into a wide surface, and, being joined by other streams, assumes the appearance of a large river. From this point its course is due west, with the straightest course of any river perhaps in the world. It passes through Gundwana, Khandesh, Mulwah, and Gujerat, and, after passing the city of Broach, falls into the Gulf of Cambay, and is navigable for boats to a considerable distance. This river was in former times the boundary between Hindustan Proper and the Deccan or southern peninsula. It is sometimes called the Reva.

NEREIDS, in the pagan theology, sea-nymphs, daughters of Nereus and Dorus. The Nereids were esteemed very handsome, insomuch that Cassiope, the wife of Cepheus, king of Ethiopia, having triumphed over all the beauties of the age, and dared to vie with the Nereids, they were so enraged that they sent a prodigious sea-monster into the country; and, to appease them, Cassiope was commanded by the oracle to expose her daughter Andromeda, bound to a rock, to be devoured by the monster. In ancient monuments, the Nereids are represented as riding upon sea-horses; sometimes with an entire human form, and at other times with the tail of a fish.

NEREUS, in fabulous history, a marine deity, was son of Oceanus and Thetis. He settled in the Ægean Sea, was considered as a prophet, had the power of assuming whatever form he pleased, and married his sister Doris, by whom he had fifty daughters called the Nereids, who constantly attended on Neptune, and when he went abroad surrounded his chariot.

NERO, CLAUDIUS CÆSAR, the sixth of the Cæsars, was the fourth Roman emperor in succession from Augustus, and descended from a family which had taken an active part in all the important political transactions of their country. This family, however, had partaken of the degeneracy of the times, and the more immediate predecessors of Nero had been more distinguished for their follies and extravagancies than for the stern virtues of the earlier ages. His grandfather, Cneius Domitius, was chiefly known for the cruelties he had allowed to be perpetrated in the gladiatorial exhibitions, which it was at last found necessary to put down by a public edict, the private remonstrances of Augustus having been disregarded. Cneius Domitius was married to Antonia Major, the elder daughter of Marc Antony by Octavia, sister to Augustus, and had by her L. Domitius, the father of Nero. L. Domitius attended C. Cæsar to the East, where he was dismissed with ignominy, because he had put to death his freedman for refusing to drink as much wine as he ordered. Towards the end of the reign of Tiberius, he was accused of a variety of enormities, and only escaped by the death of the emperor. He was married to Agrippina, the daughter of Germanicus, and the sister of Caligula the emperor.

Nero was born at Antium, in Latium, on the15th of December, A. D. 37, nine months after the murder of Tiberius, and in the first year of Caligula's reign. On receiving the congratulations of his friends, his father said that it was no subject of joy, as he was certain that nothing good could spring from such parents as himself and Agrippina. Nero lost his father in his third year, and was at the same time deprived by Caligula of his patrimonial estate. The young Nero took refuge in the house of his aunt, Æmilia Lepida, till the accession of Claudius, A. D. 41, when the property of his father was restored, and he also became the heir of his step-father, Crispus Passienus, an old rich senator, whom his mother had in the meanwhile married. In his eleventh year he was adopted by the Emperor Claudius, A. D. 48, who had been induced, by the wiles of his mother, to raise her to the imperial throne. He was now placed under the tuition of the philosopher Annæus Seneca; but the pernicious doctrines and example of a corrupt court were far more likely to make an impression upon the youthful mind of Nero than the stern doctrines of the philosopher. We must not therefore place the follies of the prince to the account of Seneca, nor conclude that he did not perform his duty towards him. In his seventeenth year, A. D. 54, he married Octavia, the daughter of Claudius; and the same year he ascended the throne (13th of October), on the death of the emperor, who was supposed to have been poisoned by Agrippina.

Nero began his reign with the usual professions of respect for the senate, and of an intention to take its opinion in all matters of importance. The administration of affairs was chiefly in the hands of Agrippina, of Burrus the prefect of the prætorian guard, and of Seneca the instructor of the emperor. The two latter tried to moderate the furious proceedings of Agrippina, and to prevent her from taking any part in public affairs. Her quarrels with Nero soon enabled them to succeed in this object, as her imperious disposition could endure no rival. Her friend Pallas, who had assisted her to get rid of Claudius, was ordered to retire from court; and Britannicus, the son of Claudius, whose cause Agrippina threatened to espouse, was removed by poison. In the meanwhile, Nero amused himself by night in traversing the streets of Rome in search of adventures: he used to attack people returning from supper, and even to break into shops and rob them, sometimes at the risk of his life. The most innocent of his amusements was music, of which he is said to have been passionately fond.

His whole time was devoted to the cultivation of this taste, and, after he had delighted the ears of private parties with his vocal powers, he at last made his appearance upon the public stage, at Naples, A. D. 64, and was of course much applauded. It is said, that whilst he was performing, the theatre was shaken violently by an earthquake, but that he was so absorbed with the music that he did not perceive it. Agrippina made many attempts to regain her influence over her son, and some of these were of the most flagitious kind; but Nero having become entirely devoted to Poppæa Sabina, was encouraged by her to get rid of Agrippina. After making several abortive attempts, he at last succeeded, A. D. 59; and, that he might be legally united to Poppæa, he ordered his wife Octavia to be put to death, A. D. 62. By Poppæa he had one daughter, who died in infancy; and he is said to have soon got rid of this woman by striking her with his heel on the stomach when she annoyed him by complaining of his being frequently absent from her. The dreadful conflagration which happened at Rome, A. D. 64, was generally believed at the time to have been caused by his orders; and it was even said, that at the moment when it was raging most furiously, he appeared on the top of the palace of Mæcenas, on the Esquiline Hill, and sung part of a tragedy entitled the Burning of Troy. It continued to rage during six days, and was only at last stopped by throwing down some of the houses, and thereby preventing the communication of the fire. The use which Nero afterwards made of the space thus cleared by the fire was a strong corroboration of the truth of the report. He appropriated the ground to himself, and erected a palace, called *Aurea Domus* from its magnificence, but which was still more remarkable for the beauty of the gardens and ground attached to it. They were laid out under the direction of Severus and Celer, two engineers, who proposed to him to cut a canal along the coast, from Lake Avernus to Ostia, a distance of 160 miles. What advantage he supposed likely to arise from such a project it is difficult to discover; but he actually commenced it in the vicinity of Cumæ, and it is supposed that the *Lago di Licola* is the remains of this foolish enterprise. Another work which he attempted had been projected by Caligula. This was to cut through the Isthmus of Corinth; and so much interest did he take in the work, that he commenced it with his own hand, in order to encourage the workmen to proceed in it with zeal. The people were so firmly convinced that the conflagration had been the work of incendiaries, that Nero found it necessary to turn the public indignation in some other direction than himself. The Christians were at this time attracting attention, and, like most new sects, were charged by their enemies with the most atrocious crimes. Nero accused them of having set fire to the city, and many were in consequence put to the most cruel deaths. His conduct had now excited very general indignation against him; and as no one felt secure of his life, a conspiracy was entered into by all the principal men in Rome, including Seneca, and Lucan the poet. It does not appear that Seneca had any thing farther to do with the conspiracy than that he was cognizant of it. The conspiracy, however, was discovered, A. D. 65, and most of the conspirators were put to death. On the murder of Poppæa, Nero proposed to marry Antonia, daughter of Claudius; but she preferred death to an union with such an inhuman monster. He married Statilia Messalina, by whom he had no children. The first circumstance which excited his alarm was the revolt of Vindex, governor of Gaul, who published a manifesto against him, in which he gave the greatest annoyance to Nero by calling him a miserable and despicable musician. Nothing could have given Nero greater pain than such an assertion. A few days afterwards he received intelligence from Spain of the desertion of Galba, who was destined to be emperor; and he at once gave himself up for lost. He sent some of his most faithful freedmen to prepare some ships at Ostia for flight, and in the meanwhile solicited some tribunes and centurions of the prætorian guard to accompany him; but on various pretexts they refused. He soon found himself completely abandoned by all except a few of his freedmen, one of whom, Phaon, offered to conceal him in his villa, about four miles from Rome, between the Via Salaria and Nomentana. But on his way thither he was recognised by a soldier, and though he reached his place of concealment, he was soon discovered, and had only time to give himself a mortal wound when his enemies appeared. He died on the 9th of June, A. D. 68, in the thirty-second year of his age, and the anniversary day on which he had put his wife Octavia to death. He was succeeded by Galba, the last of the family of Augustus who ruled the Roman empire. (Suetonius' Life of Nero; Dion. Cassius, in the Extracts of Zephilinus; Tacitus' Annals, books xiii.–xvi.)

NERTSCHINK, a town of Asia, under the jurisdiction of Russia. It is situated on the Chinese frontier; but its importance has much declined since the route of the Chinese caravans, which was formerly through this town, has been changed to the route of Selinginsk. A few merchants still remain, who carry on a small fur trade, particularly in sables. It was built in 1658, and was then merely a palisadoed fort; but in 1781 it was raised to the rank of a town. It contains two churches, and about 2000 inhabitants, including the military. The neighbouring mountains afford excellent pasturage, but the district is chiefly distinguished by the mines of lead and silver, which are worked by the crown; and persons condemned to exile are employed in this remote part of the empire. Long. 116. 44. E. Lat. 51. 56. N.

NERVA, M. COCCEIUS, the eleventh Roman emperor in succession from Augustus, was born A. D. 33, in the twentieth year of the reign of Tiberius. It is curious that his name is scarcely mentioned in history till he ascended the imperial throne, after he had passed his sixtieth year. He was probably the relation of Cocceius Nerva, who is described by Tacitus (*Ann.* vi. 26) as distinguished for his knowledge of law, and as having put himself to death rather than survive his friends, who had fallen a sacrifice to the tyranny of Tiberius. We find him consul A. D. 71, being the second year of the reign of Vespasian, and a second time A. D. 90, in the tenth year of the reign of Domitian; but history records nothing for which he was distinguished. Towards the close of Domitian's reign, he was in exile with many good men at Tarentum; and hearing of the bold defence made by Pliny the younger for the inhabitants of Bœtica against Bœbius Massa, he wrote to Pliny to congratulate him on the example he had given. (Plin. Ep. iii. 33.) When the conspirators had resolved to put to death the Emperor Domitian, they found it no easy task to discover a person who would agree to be his successor, as every one suspected that it was a snare laid by Domitian himself to entrap them. Nerva, however, was persuaded to run the risk, an astrologer having some time before predicted that he would ascend the imperial throne. Domitian was murdered on the 18th of September A. D. 96, and Nerva was on the same day saluted emperor. The kind and benevolent disposition of Nerva must have been doubly felt from its strong contrast with the ferocious cruelty of his predecessor. One of his first acts was to release all those who had been accused of what was designated impiety, which consisted of the slightest neglect of respect to the emperor or his statues. This law was of so comprehensive a nature, that it was scarcely possible to escape, and the only chance seemed to be, by being active in the accusation of others. Domitian had also passed a severe law against those who practised Jewish rites, by which profane writers no doubt meant the followers of the Christian religion; but Nerva refused to listen to any such accusations. Whatever property had been taken unjustly by Domitian he restored to its lawful owners; and he at the same time did every thing in his power to lessen the expenses of the state. He swore in the senate that no senator should be put to death by his orders; and even when a conspiracy was formed against him, he kept to his resolution. He used frequently to say that he had done nothing to prevent him living in safety as a private citizen if he chose to lay down his authority. In nothing did he show his sagacity and his anxiety to secure the happiness of the empire more than by his adoption of M. Ulpius Nerva Trajanus to be his successor, although he was not without many near relatives. He died, after a reign of sixteen months, on the 27th of January, A. D. 98, in the sixty-fifth year of his age. (Xiphilinus, Extracts from Dion Cassius.)

NERVES, certain white glistening chords, proceeding from the brain and spinal marrow, and dividing into very small branches, which are sent off throughout all parts of the body, and which form the organs of sensation and motion.

NESA, a town of Khorasm, or Independent Tartary, which was taken and nearly destroyed by Genghis Khan in 1221, after a siege of fifteen days. It is situated near the Persian province of Khorassan, 100 miles north of Meshed.

NESHIN, a circle in the Russian province Tschernigow, extending in north latitude from 50. 32. to 52. 26. and in east longitude from 21. 19. to 22. 43. It is one of the most extensive but poorest portions of the ancient Ukraine. The capital is a city of the same name, situated on the river Ostin, 822 miles from St Petersburg, and is the best built city, not only of the province, but of the country which was formerly known as Little Russia. It is surrounded with walls and defended by a citadel; and it contains fifteen churches, 3000 houses, and 16,500 industrious inhabitants. There are several establishments of Greeks and Arminians, who have manufactories of silk goods, soap, leather, liqueurs, and especially of perfumery, which is dispersed throughout the whole of Russia, and sent into Moldavia, Poland, Hungary, and even to Vienna. There are three great annual fairs, at which much business is transacted in wool, tobacco, honey, wax, salt, and manufactured goods. Public schools are maintained for instruction in the classical languages, and in modern Greek. It is situated in north latitude 51. 2. 45. and east longitude 21. 44. 25.

NESSUS, in fabulous history, was a celebrated Centaur, the son of Ixion and a Cloud. He offered violence to Dejanira, whom Hercules had intrusted to his care, with orders to carry her across the river Evenus. Hercules saw the distress of his wife from the opposite shore of the river, and immediately let fly one of his poisoned arrows, which struck the Centaur to the heart. Nessus, as he expired, gave the tunic which he then wore to Dejanira, assuring her that from the poisoned blood which flowed from his wound it had received the power of calling a husband away from unlawful loves. Dejanira received it with pleasure, and this mournful present caused the death of Hercules.

NESTON, a town of the county of Chester, in the hundred of Wirral, near Parkgate, ten miles from the city of Chester, and 190 miles from London. The parish is large, and contains no fewer than seven other townships. Great Neston had, in 1801, 1486 inhabitants; in 1811, 1332; in 1821, 1418; and in 1831, 1633.

NESTOR, in fabulous history, was the son of Neleus and Chloris, nephew to Pelias, and grandson to Neptune. He had eleven brothers, who, with his father, were all killed by Hercules. His tender age detained him at home, and proved the cause of his preservation. The conqueror spared his life, and placed him upon the throne of Pylos. He married Eurydice, the daughter of Clymenus; or, according to others, Anaxibia, the daughter of Atreus. He soon distinguished himself in the field of battle, and was present at the nuptials of Pirithous, when a bloody encounter took place between the Centaurs and the Lapithæ. As king of Pylos and Messenia, he led his subjects to the Trojan war, where he distinguished himself amongst the Grecian chiefs, by his eloquence, address, wisdom, justice, and sagacity. After the Trojan war, Nestor returned to Greece, where he enjoyed in the bosom of his family the peace and tranquillity which were necessary at his advanced age. The manner and the time of his death are equally unknown. The ancients are all agreed that he outlived three generations of men. He had two daughters, Pisidice and Polycaste; and seven sons, Perseus, Straticus, Aretus, Echephron, Pisistratus, Antilochus, and Thrasymedes.

NESTOR, a person whose secular name is not known, was a native of Russia, and the earliest historian of the north. He was born at the town of Bielozero in the year 1056, and in the nineteenth year of his age he assumed the monastic habit, in the convent of Petcherski, at Kiew, and took the name of Nestor. He there made considerable proficiency in the Greek language, but appears to have formed his style and manner rather from the study of the Byzantine historians, Cedrenus, Zonaras, and Syncellus, than from that of the ancient classics. The time of Nestor's death has not been ascertained; but he is supposed to have lived to an advanced age, and to have died about the year 1115. His great work is his *Chronicle*, to which he has prefixed an introduction. In this work, after a short sketch of the early state of the world, taken from the Byzantine writers, he gives a geographical description of Russia and the adjacent regions; with an account of the Sclavonian nations, their manners, their emigrations from the banks of the Danube, their dispersion, and their settlement in the several countries in which their descendants are now established. He then enters upon a chronological series of the Russian annals, from the year 858 to about 1113. His style is simple and unadorned, being such as best suits a mere recorder of facts; and his chronological exactness, although it renders his narrative dry and tedious, has enabled him to fix the era and to determine the authenticity of the events which he relates.

NESTORIANS, a sect of ancient Christians, who held that Mary was not the mother of God. They received their name from Nestorius, bishop of Constantinople, whose doctrines were spread with much zeal throughout Syria, Egypt, and Persia. One of the chief promoters of the Nestorian cause was Barsumas, who appears to have been created Bishop of Nisibis in the year 435. Such were his zeal and success, that the Nestorians considered him alone as their parent and founder. By him Pherozes the Persian monarch was persuaded to expel those Christians who had adopted the opinions of the Greeks; to admit the Nestorians in their place; and to put the latter in possession of the principal seat of ecclesiastical authority in Persia, namely, the see of Seleucia. Barsumas also erected at Nisibis a school, from which proceeded those Nestorian doctors who in the fifth and sixth centuries spread their tenets throughout Egypt, Syria, Arabia, India, Tartary, and China. He differed considerably from Nestorius, in holding that there are two persons in Jesus Christ, as well as that the virgin was not his mother as God, but only as man. The abettors of this doctrine refuse the title Nestorians, alleging that it had been handed down from the earliest times of the Christian church. In the tenth century, the Nestorians in Chaldæa, whence they were sometimes called *Chaldæans*, extended their spiritual conquests beyond the Imaus, and introduced the Christian religion into Tartary properly so called, espe-

Nestorius. cially into the country bordering on the northern part of China. The prince of that country, whom the Nestorians converted to the Christian faith, is said to have assumed, after his baptism, the name of John, to which, from a principle of modesty, he added the surname of presbyter; and hence it is said that his successors were each of them called *Prester John* until the time of Ghengis Khan. But Mosheim observes, that the famous Prester John did not begin to reign in that part of Asia before the conclusion of the eleventh century. The Nestorians formed so considerable a body of Christians, that the missionaries of Rome were industrious in their endeavours to reduce them under the papal yoke; and for this purpose Innocent IV. in 1246, and Nicolas IV. in 1278, employed their utmost efforts, but without success. Till the time of Julius III. the Nestorians acknowledged but one patriarch, who resided first at Bagdad, and afterwards at Mosul; but a division having arisen amongst them, in the year 1551 the patriarchate became divided, at least for a time, and Julius consecrated a new patriarch, whose successors fixed their residence in the city of Ormus, in the mountainous part of Persia, where they were distinguished by the name of Simeon. The great Nestorian pontiffs, who form the opposite party, and look with a hostile eye on this patriarch, have since the year 1559 been distinguished by the name of Elias, and reside constantly in the city of Mosul. Their spiritual dominion is very extensive, including a great part of Asia, and comprehending also within its circuit the Arabian Nestorians, and the Christians of St Thomas, who dwell along the coast of Malabar. About the middle of the seventeenth century, the Catholic missionaries gained over to the communion of Rome a small number of Nestorians, whom they formed into a congregation or church, the patriarchs or bishops of which resided in the city of Amida, or Diarbekir, and all assumed the denomination of Joseph. But the Nestorians in general persevered in their refusal to enter into the communion of the Church of Rome.

NESTORIUS, from whom the sect of Nestorian Christians derive their name, was born in Germanica, a city of Syria. He received his education at Antioch, where he was likewise baptized; and soon afterwards he withdrew to a monastery in the suburbs of that city. Upon being admitted into the order of priesthood, he acquired so great reputation, by the eloquence of his preaching, and the regularity of his life, that the Emperor Theodosius deemed him a fit person to fill the second see in the Christian church; and he was accordingly consecrated Bishop of Constantinople in the year 429. In one of his first sermons after his promotion, he publicly declared his intention to make war upon heretics, and called upon the emperor to free the earth from heretics, promising to give him heaven as a reward for his zeal; and adding, "Join with me in war against them, and I will assist you against the Persians." Although the wiser and better part of his audience were amazed to see a man, before he had tasted the water of his city, as an historian expresses it, declare that he would persecute all who were not of his opinion, yet the majority of the people approved of this discourse, and encouraged him to execute his purpose. Accordingly, five days after his consecration, he attempted to demolish the church in which the Arians secretly held their assemblies; and he succeeded so far in his design, that these people, rendered desperate, set it on fire of their own accord, by which means it was consumed, along with some of the neighbouring houses. This fire excited great commotions in the city, and Nestorius was ever afterwards called an incendiary.

From the Arians he turned his persecution against the Novatians, but was checked in his career by the interposition of the emperor. He then let loose his fury upon those Christians of Asia, Lydia, and Caria, who celebrated the feast of Easter upon the fourteenth day of the moon; and for this unimportant deviation from the Catholic practice, many of these people were murdered by his agents, both at Miletum and Sardis. One can scarcely regret that such a relentless persecutor should himself have been afterwards condemned as a heretic, for holding an opinion which no man out of the church of Rome will now venture to controvert. The obnoxious tenet which produced a schism in the church, and was condemned by a general council, consisted in maintaining that the Virgin Mary cannot with propriety be called the mother of God. The people being accustomed to hear this expression, were much inflamed against their bishop, imagining that he had revived the error of Paul of Samosata and Photinus, who taught that Jesus Christ was a mere man. The monks declared openly against him, and, along with some of the most considerable men of Constantinople, separated themselves from his communion. Several bishops wrote to him, earnestly urging him to acknowledge that Mary was the mother of God; and when he refused to comply, they procured his condemnation in the council of Ephesus, which deprived him of his see. He then withdrew to his former retreat at Antioch, whence, four years afterwards, he was removed by the emperor's order, and in 435 banished to Tarsus; and when that city was taken and destroyed by the barbarians, he was transferred to Panopolis, a city of Thebais. But he was not suffered to remain long there, and being compelled to wander from place to place, having received a severe bruise in one of his journeys, death soon relieved him from the rage of his persecutors.

If we examine such of his writings as remain, we shall find that he was unjustly condemned. It appears that he rejected the errors of Ebion, Paul of Samosata, and Photinus; that he maintained in express terms, that the Divine Word was united to the human nature in Jesus Christ in the most strict and intimate sense possible; that these two natures, in this state of hypostatical union, make but one Christ and one person; that the properties of the divine and human natures may both be attributed to this person; and that Jesus Christ may be said to have been born of a virgin, to have suffered and died. But he would never admit that God could be said to have been born, to have suffered, or to have died.

Net. NET, a device for catching fishes and fowls. The taking of fowls by means of nets is the readiest and most advantageous method, where numbers are to be caught. The making of the nets is very easy, and what every true sportsman ought to do for himself. All the necessary tools are, wooden needles, of which there should be several of different sizes, some round, and others flat; a pair of round pointed and flat scissars; and a wheel to wind off the thread. The pack-thread should be of different strength and thickness, according to the sort of birds to be taken; and the general size of the meshes, if not for very small birds, should be two inches from point to point. The nets should neither be made too deep nor too long, for they are then difficult to manage; and they must be verged on each side with twisted thread. The natural colour of the thread is too bright and pale, and it should therefore in many cases be altered. The most usual colour is the russet, which is to be obtained by plunging the net, after it is made, into a tanner's pit, and letting it lie there till it be sufficiently tinged. This is of a double service to the net, since it preserves the thread as well as alters the colour. The green colour is given by chopping some green wheat and boiling it in water, and then soaking the net in this green tincture. The yellow colour is given in the same manner, with a decoction of celandine, which gives a pale straw-colour, like that of stubble in the harvest-time. The brown nets should be used on ploughed lands, the green on grass grounds, and the yellow on stubble lands.

NETHERLANDS.

In the article Holland has been traced the history of the revolt of the seventeen provinces of the Netherlands against the Spanish monarchy, and the subjugation of the greater part of ten provinces to that power in the year 1578, whilst the remaining seven provinces, under the Prince of Orange, maintained and ultimately secured their independence in a republican form. Whilst this work has been in progress, a change has been effected in the Netherlands, terminating in a division which renders it necessary to introduce here an account of the new kingdom of Belgium; the name which has been assumed by the southern part of what was formerly the kingdom of the Netherlands.

The decisive battle of Gemblours, on the 31st of January 1578, which terminated in favour of the Spaniards, and in the dispersion of the army of the states, with the loss of all its artillery, baggage, and stores, must be viewed as the event by which the history of the Netherlands is separated from that of the seven united provinces, which were collectively called Holland, after the first of these states. The archduke, better known by the name of Don Juan, having gained this victory, was suddenly arrested by the hand of death whilst following up his success; and his death has generally, but on insufficient evidence, been attributed to the effects of poison. He was immediately succeeded by the Prince Alexander Farnese, the son of the Duke of Parma and Piacenza, in Italy, by Margaret of Austria, a daughter of the Emperor Charles V., who had formerly governed the Low Countries under the authority of Philip king of Spain. On his accession to the command, the provinces were in a most unsettled state. Don Juan had feared to attack the partisans of the Prince of Orange, who held possession of Brussels; but he was successful in seizing upon Tirlemont, Louvain, Bovines, Philippeville, and several other smaller but fortified places. These successes were, however, more than counterbalanced by the loss of Amsterdam, where the inhabitants rose on the Spanish garrison, and, having succeeded in driving out the troops, boldly declared in favour of the Prince of Orange. The great strength of the Spanish party in the ten provinces depended more on their union under one chief, and on the discipline of the few regular troops whom they had been able to collect, than on the number of soldiers or the abundance of pecuniary resources. The people of the Walloon provinces were bigotedly attached to the church of Rome, and were ready to give up their whole civil rights rather than abandon an iota of that faith, or a single religious observance to which they had been accustomed. These constituted the chief reliance of the Spanish monarch; and under obedience to him had remained, or returned, the fortified towns on the frontier towards France, such as Lisle, Valenciennes, Courtray, and several others. In the party opposed to the Spaniards, though there was a greater number of the population, and a far greater power in warlike stores and in pecuniary resources, yet there were such party divisions and contests, and such struggles for power between chiefs, as tended much to weaken the effect of their efforts to drive out the Spaniards, or even to maintain against them the power which they still held in Brussels, and in the commercial and maritime cities.

Although the Prince of Orange, by his talents and his virtues, was at the head of the general confederacy, and, after the independence of the seven provinces had been secured, clothed with unqualified authority within them; yet in the transactions of the ten provinces, which were to be the chief theatre of future warfare, faction had raised up powerful rivals, who impeded his wisest plans. Amongst those of his party who still adhered to the Catholic faith, and were anxious to preserve it, without yielding up to Spain the civil privileges they had long enjoyed, was the Duke of Arschot, the head of a powerful family, who strove to awaken the jealousy of the aristocracy of Flanders and Brabant against the power which the seven northern provinces had bestowed on William of Orange. In order to counterbalance that power, they resolved upon sending an invitation to the Archduke Mathias, the brother of the Emperor Rudolf II., a youth under twenty years of age, to accept the office of governor of Flanders. A secret messenger was despatched to Vienna, and communicated with the archduke, who, with the precipitation of youth, ardently accepted the offer; withdrew privately from Vienna without imparting his project to his brother; and with great celerity and secrecy arrived at Maestricht without previously having announced his resolution, which was scarcely expected by the party that had invited him, and quite unexpected by the Prince of Orange and his friends.

That prince, with his usual coolness and prudence, expressed neither surprise nor dissatisfaction at this unwarrantable intrigue against his authority; but, on the contrary, he became, or appeared to become, anxious for adopting any measures which could do honour to Mathias, and at the same time increase the security of the country. He framed the outline of the plan upon which his office was to be founded and the power granted to him, but so much under the virtual sovereignty of the states general, as to leave little to the thoughtless youth but the empty title by which he had been tempted to make this wild excursion. The Prince of Orange was appointed his lieutenant in the several civil and military departments of the government, and the Duke of Arschot was left, with little power and less influence, to brood over the disappointment of his ambitious scheme. As his power was but of small extent, he soon resigned it with good humour; and the states, who had only adopted him in the hope of thereby obtaining foreign assistance, when they found he was not supported by his brother or by the empire, accepted his resignation, and dismissed him with an unanimous vote of thanks for his services. After some difficulty, Mathias was allowed by his brother to return to the Austrian dominions, and was promoted to the government of the hereditary provinces, and intrusted with the command of an army in Hungary against the Turks, by which he acquired much reputation, and ultimately succeeded, after much intrigue and dissension, to the imperial throne, which he filled till his death in 1619. His history belongs rather to that of Austria than to that of the Netherlands.

The Prince of Orange had been regularly installed in the dignity of chief of the seven united provinces, in which he was confirmed by a treaty entered into by the states of Flanders and Brabant, who, in an assembly at Brussels, had agreed to confer on the then Duke of Alençon, afterwards Duke of Anjou, the brother of the king of France, the dignity of Duke of Brabant, Lothier, Limbourg, and Guelders. At this period the Duke of Parma collected an army in order to take the city of Cambray; but the siege, which he carried on in person, was raised by the opportune arrival of the Duke of Anjou at the head of a large army of French troops. After the retreat of the Spaniards from before Cambray, the Duke of Parma marched to Tournay, a large city, though at that time feebly garrisoned. The inhabitants, mostly Protestants, made a powerful defence, excited by the example of the Princess of Epinol, wife of the absent governor. This heroic lady, though wounded in the attack, fought in the breach, sword in hand; and, when it was impossible to continue the resistance, she obtained an honourable capitulation, and marched out at the head of the garrison, with the appearance of a triumph rather than that of a defeat.

The Duke of Anjou, after the delivery of Cambray, leaving his army on the frontiers of Flanders, repaired to England, in the hope of completing a treaty which had before been commenced for his marriage with Queen Elizabeth. That sovereign allowed him for some time to indulge hopes of succeeding in his suit; and, from political motives, when the offer was finally rejected, showed him every mark of feeling and regret, accompanied with such tokens of high respect as she supposed would lessen the mortification which he felt. His plan evidently was to unite on his own head the crowns of England and of Belgium.

The duke, escorted by a powerful English fleet, repaired to Antwerp, where he was received by the Prince of Orange with the greatest splendour, and invested with the insignia of the dignities to which he had been invited, but of which he proved himself utterly unworthy. It is related of him, that when the Prince of Orange placed the ducal mantle on his shoulder, Anjou said to him, "Fasten it so well, prince, that they may not be able to take it off again."

The king of Spain had about this period issued a paper full of invective, abuse, and falsehoods against the Prince of Orange, who was therein proscribed, and all persons invited "to assail him in his fortune, person, and life, as an enemy to human nature;" and for the recompense of virtue and the punishment of vice, he promised, to any one who should deliver up William of Nassau, dead or alive, the sum of 25,000 golden ducats, in lands or money, at his choice; to grant a free pardon to such person for all former offences, of whatever kind; and to invest him with letters-patent of nobility. To this infamous paper William replied by that Apology which Voltaire has described as "one of the noblest monuments of history," in which he delivered a most splendid refutation of every charge against him, and a more terrible recrimination against the guilty tyrant. He thus stood before the whole public of Europe, not as a rebellious subject, but as the accuser of a king, who had disgraced his ancestors and his throne.

The inauguration of the Duke of Anjou at Antwerp gave occasion to continued festivities, and the opportunity was seized in order to put in practice that which the declaration of King Philip had intimated, and promised to reward. After a dinner on the Duke of Anjou's birth-day, being the 18th of March, and as William was quitting the dining-room on the way to his private apartment, a young man stepped forward to offer what purported to be a petition. Whilst he read the paper, the treacherous suppliant discharged a pistol at his head; the ball struck him under the left ear, and passed out at the right cheek. As he tottered and fell, the assassin drew forth a poniard to complete his crime by suicide, but he was instantly put to death by the attendant guards.

Papers found upon the assassin proved him to be a Spaniard, a native of Bilboa, and clerk to a Spanish merchant of Antwerp. They showed that he had received the sacrament and confessed previous to the attempt, and that he was encouraged to the deed by prayers found amongst his papers in the Spanish language, one of them addressed to the angel Gabriel, imploring his intercession with God and the Virgin to aid him in the completion of his object. This young fanatic was shown afterwards to have been instigated to the crime by his master and a Dominican monk, who were tried, and, before their execution, made a full confession of their criminality. It is asserted by D'Ewes, that the Jesuits, some years afterwards, solemnly gathered the remains of the three pretended martyrs, and exhibited them as holy relics for public veneration.

Severe as was the wound inflicted on the prince, it did not prove fatal; but within three months he had so far recovered as to be able to accompany the Duke of Anjou to Ghent, Bruges, and the other great towns of Flanders, in each of which the same ceremony of inauguration was performed. On each occasion he had taken the prescribed oaths to maintain and preserve to the states-general the several rights and privileges they had inherited from the succession of princes who had for a long period governed the country. The duke soon began to compare the power he possessed with that held by the unlimited monarchs of the rest of Europe. He was found to be intemperate, inconstant, and utterly unprincipled; and the French officers who surrounded him, and alone enjoyed his confidence, had no great difficulty, whilst nourishing his discontent at his limited power, in exciting him to take the most treacherous steps to extend his own authority, and to extinguish the liberties of the people which he had been invited to defend, and had sworn to maintain.

Amongst these privileges, that of refusing to admit foreign troops to garrison the fortified towns was the one which those towns most zealously exercised. Though the smaller towns had overlooked slight infractions of this privilege, yet the larger ones, especially Antwerp, most sedulously preserved it. Whilst a few of Anjou's troops were admitted into some places, the main body was either encamped or cantoned in quarters in the villages.

He had secretly resolved on seizing on the towns, and sent orders to his officers to take possession in his name of Dunkirk, Bruges, Termonde, and some other places, reserving to himself the attempt to be made upon Antwerp. To prepare for the execution of his project, he had ordered his numerous army, composed chiefly of French and Swiss, to approach the city, and form a camp very near to it. On the 17th of January 1583, having risen earlier than usual, under the pretext of going out afterwards to review his army in the camp, he set out at noon, accompanied by his guard of 200 horse; and when he had reached the second drawbridge, one of his officers gave the preconcerted signal for an attack on the Flemish guard, by pretending that he had fallen and broken his leg. The duke called out to his followers, "Courage, courage; the town is ours." The guard of Flemings at the gate was soon despatched; and the French troops, which waited without to the number of 3000, rushed in furiously, shouting the war-cry, "Town taken, town taken; kill, kill!" The astonished but intrepid citizens, recovering from their confusion, instantly flew to arms. All differences in religion and politics were forgotten in the common danger to their freedom. Catholics and Protestants, men and women, rushed alike to the conflict. The ancient spirit of Flanders seemed to animate all. Workmen, armed only with the instruments of their various trades, started from their shops, and flung themselves on the enemy. Those who had fire-arms, after expending their bullets, took from their pockets and pouches pieces of money, which they bent between their teeth, and used for charging their arquebuses. The French were driven successively from the streets and ramparts; and the cannons planted on the latter were immediately turned against the reinforcements which attempted to enter the town. The French were beaten everywhere; the Duke of Anjou saved himself by flight, and reached Termonde after the perilous exploit of passing through a large tract of inundated country. His loss in this atrocious enterprise amounted to 1500, whilst that of the citizens did not exceed eighty men. The attempts of the same kind simultaneously made at Dunkirk and at Termonde succeeded, but they failed in all the other places.

The consternation first, and soon afterwards the indig-

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nation, of the whole of Belgium, excited by this act of treachery, is indescribable; but the Prince of Orange alone was cool and collected, and on the Duke of Anjou making abundance of professions of his repentance, of his submission, and of future fidelity and obedience to the states, he was disposed to some kind of reconciliation, especially as his brother the king of France despatched a special envoy to intercede for him. A treaty was then commenced, the tendency of which was to restore to Anjou the command of the troops, with some new security against treachery on his part. He had in the mean time withdrawn to France to escape the general burst of indignation, and there his worthless existence was suddenly terminated, as some thought by poison, which in that day was commonly supposed to be the cause of unexpected death. He had then scarcely attained his twenty-ninth year.

The conduct of the Prince of Orange in trying to reconcile the states to the re-assumption of command by Anjou, although it could not arise from any selfish views, since he might himself have easily obtained the supreme power, was misunderstood by many of the Belgians, but more especially by the people of Antwerp. Unable to comprehend the greatness of his mind, they openly accused him of having joined with the French for their subjugation, and concealed a body of that detested nation in the citadel. The populace rushed to the place, and having minutely examined it, were convinced of their own folly and the prince's innocence. He scorned to demand their punishment for such an outrageous calumny, but he was not the less afflicted at it. He took the resolution of quitting Flanders; and he retired into Zealand, where he was better known, and consequently more trusted.

The cities of Belgium which were free from the domination of Spain were all more or less subject to the most violent political agitations, the bad effects of which were not lightened, but rather increased, by being mixed up with the prevailing religious differences of the times. The evils of this state of public feeling displayed themselves more extensively, and during a longer period, in the city of Ghent, the capital of the province of West Flanders, than in any other part of the Netherlands. The persecutions of the Spaniards had driven the Flemings to a state of frenzy, which destroyed the exercise of reflection. Hatred to Spain begat hatred to that which Spain most cherished, the Catholic religion; and it is not to be wondered that the lower classes in the cities should, from passion rather than from reason, have taken part with those more intelligent persons who had embraced the Protestant religion; and it must be added, that the persons who envied the property of the convents and churches, and who were anxious to seize upon that wealth and convert it to their own use, vastly augmented the adherents of the Protestant party. In Ghent, two men had taken advantage of these circumstances, and thereby gained an unbounded and most noxious ascendency over the public mind. John de Hembise is described by Vandervynkt as a man descended from a junior branch of a good family, educated, fluent and even eloquent, and well informed on every subject relating to his own country; but, on the other hand, a sceptic, destitute of morals, capable of assuming any character either sacred or profane, impatient of all control, and treating with contempt all who were in superior stations. Besides these qualities, his history shows that he was bold, despotic, and imperious in prosperity, but did not exhibit the same courage in adversity. The other, Francis de Kethule, lord of Ryhove, was also of a distinguished family, but of a character similar to Hembise, only much more violent and imprudent; but those qualities were somewhat checked by his adherence to the Prince of Orange, whose calm wisdom exercised at times some influence on his conduct.

These two men, with all the qualifications necessary for demagogues, were allied with many of the respectable families of the city, amongst whom they gained some partisans; but their chief adherents were furnished in part by the burghers, and by almost all the mere populace. Though afterwards they differed, at first they acted in concert; and as they most vehemently preached nothing but liberty, they were soon regarded by the populace as the heroes and the liberators of their country. The Duke of Arschot had been appointed governor of the city, with the approbation of the Prince of Orange; and, though opposed by both the demagogues, he was seated in the dignity. He had drawn to him as a council the Bishops of Bruges and Ypres, the high bailiffs of Ghent and Courtray, and the governor of Oudenarde, and other eminent magistrates. Whilst they were assembled in council, the popular leaders collected a force of the lower classes, and, without even allowing him to dress himself, led him away to prison. They then seized the arsenal, armed the population, and soon had under their command a body of 20,000 well-armed and resolute men. The constitution of the city was changed, and the public treasury was seized upon, by the new rulers, who assumed the title of consuls; Ryhove being placed in the command of the military, and Hembise at the head of the civil power. The two consuls then nominated eighteen of their own partisans, to whom was intrusted the supreme power of what they denominated the republic. The several guilds were ordered to elect officers, amongst whom the ranks of colonels, captains, and other grades, were distributed; and the more wealthy and respectable inhabitants were excluded from any participation in power. The influence of the other states of Belgium, headed by the Prince of Orange, was ineffectual in checking the violent proceedings of the city, further than in procuring the release of the imprisoned duke. The two heads of the democracy fortified the city, and thus gave employment to the poor, and extracted from the rich the means of paying them. The rich abbeys and other religious houses were plundered, the occupiers turned out destitute, and the buildings converted into barracks for the troops and labourers. Whilst one of the consuls ruled in the city, the other issued forth with detachments of troops, laid waste the surrounding country, and subjected several of the towns in the vicinity to the horrid despotism exercised in the name of liberty. When any persons were known or suspected to be averse to the system of terror, if they were rich they were amerced in very heavy sums, or, if not able to furnish the requisitions, were, without trial, exiled, and in some instances put to death in secret. These calamities were so deeply felt that many of the gentry and burghers became voluntary exiles, and removed to France, to Holland, or to Brabant, so that when thus left only to the demagogues and the democrats, they found they had put in movement a machine which they could neither direct nor stop. When the people became tired of anarchy, and sick of the sufferings they had caused and endured, the Prince of Orange determined to proceed to Ghent. Hembise did all in his power, by his harangues to the populace, to prevent his admission; but with the venality of such assemblages his eloquence now failed. He was seized with a cowardly panic, and attempted to withdraw privately by night. He had entered a boat to descend the river, when one of his partisans recognised him, and exclaimed, "Point de fuite; tu nous as mené dans le bourbier; il faut nous en tirer, ou périr avec nous." He then made him land from the boat, and followed him to the city, where he remained in private, employed without success in exciting tumults, whilst the prince was in the city.

William of Orange reached Ghent in August 1579, and in a short time extinguished the spirit of democracy; but though he restored the ancient constitution, and re-established some of the ancient magistracy, he could not restore the wealth and the industry that had been destroyed or dissipated under the reign of democratic terror. Hembise retired from the city for four years; and, though it is anticipating the course of our narrative, it may be stated here, that, having again acquired a degree of influence, he made use of it to betray the city into the hands of the Spaniards, his mortal enmity to whom had been the original cause of his popularity. But he failed in his purpose. His designs were detected and exposed; his partisans abandoned him; and he was carried before the criminal tribunal, where, having defended himself very feebly, he was condemned to death. The sentence of decapitation was executed on the 4th of August 1584. His coadjutor Ryhove had before withdrawn from Flanders, and found an asylum in Holland, where, after a long illness, which terminated in fixed insanity, he died.

The transactions which have been noticed with regard to the Archduke Mathias, the Duke of Anjou, and the demagogues of Ghent, were the principal causes that led to the submission of the ten provinces of the Netherlands to the crown of Spain. Others, however, contributed in a greater or less degree to the same result. The differences between the Catholics and their opponents pervaded every one of the towns; and as the respective parties preponderated in any one place, they had no hesitation in persecuting the others. It was of little avail that the states had issued a law called that of the peace of religion, by which, in places where there were a hundred families and upwards of either faith, they should be allowed the public exercise of their worship; and in the smaller places the majority should have the churches, but the minority might open others. This might have tended to peace, if not to union; but, to the great mortification of the Prince of Orange, the clergy of both parties, by their influence over their followers, rendered the edict inoperative, and seem to have increased rather than abated the animosity. In Holland and in Zealand, however, there was a greater degree of religious tranquillity than in the southern provinces.

These troubles paved the way to the submission or conquest of the greater part of the ten provinces. This was the more easily effected, because the people, wearied out with their sufferings, had learned that security to their persons and their property was of far greater benefit to them than any of those kinds of liberty which the several adverse parties pretended to bestow on them. The assassination of the Prince of Orange in 1584, though not contrived by the Prince of Parma, but at the court of Madrid, was communicated to that commander before its perpetration, and he prepared the measures to be adopted when the iniquitous design should have been consummated. In the consternation produced by that event, those parts of Belgium which were free from the Spanish dominion sent their representatives to Antwerp, where they were joined by others from the Dutch states. In this assembly it was resolved to offer the sovereignty of the whole to the king of France; and ambassadors were immediately despatched to Paris. The king, Henry III., received them with great distinction; but his affairs were so much embarrassed with his internal disorders that he found himself unable to tender any effectual aid to the Netherlands. On the termination of this embassy, another was despatched to England to make a similar tender of the sovereignty to Queen Elizabeth. She civilly declined to accept the supreme power thus offered, but agreed to treat them as allies, and to send to their aid an army of 6000 men, and large pecuniary supplies. This was instantly performed; and her favourite, the Earl of Leicester, repaired to Holland, where the towns of Flushing, the Brett, and the fortress of Rammekens, were delivered up to him as securities. As that force only entered Holland, the conduct and the operations of it belong rather to the history of Holland than to that of those parts of the Netherlands which were soon afterwards wholly separated from it, and to which we here direct our attention.

Whilst these negotiations were in progress, the Prince of Parma on his side was active and acute, and contrived to enter into treaties with some of the leading inhabitants of those cities in Flanders which had hitherto resisted the Spanish dominion. By various measures, applied in various ways, he obtained possession, first of Ypres, and afterwards of Bruges and some other places, by which he was enabled to cut off the supply of stores and provisions from Ghent. He then formed a camp sufficiently near to complete the blockade. Scarcity soon appeared, and was followed by almost absolute famine. Agitations and factions reigned in the city; yet, by flattering reports of succours expected, the orators of the populace were for a time enabled to delay surrendering. But at length a capitulation was agreed to in September 1584. The terms were, that in future the Catholic worship alone should be performed, and no other be tolerated; that all who chose to do so should be allowed two years to dispose of their property and to leave the city; that the clergy should be established in their property as before the troubles, and the city should pay as a contribution the sum of two hundred thousand florins, and allot quarters to the troops. A few of the most violent of the partisans were excepted from the general indemnity. At first the number of exceptions were limited to six, and then reduced to three; but these persons were, after an imprisonment of a few weeks, liberated, and allowed to depart from the city.

During the operations against Ghent, the Prince of Parma had begun his preparations for the most important of all his military designs, the capture of Antwerp. With this view his army was gradually drawn around it, and a camp formed at Bevern, near the city. As a part of the preparation for this object, it was necessary to menace the large cities of the province of Brabant which still repudiated the Spanish power, such as Brussels and Mechlin, and to seize upon those which were less formidable. Parma took first Vilvorde, and then Willebrocke; and the capture of these places soon caused scarcity to be felt in the cities. Brabant, now so well cultivated and fertile, had suffered most severely during the troubles; and, for some months after the last harvest, whatever could be obtained was conveyed to the city of Antwerp, to provide against the impending siege by the one party, or to furnish the army destined to attack it by the other. Brussels first felt the misery of famine, and the interception of a convoy destined to supply its wants raised the discontent of the inhabitants to such a height, that Temple, an English officer in command of the garrison, and the civil governor, were obliged to send deputies to the camp of the Prince of Parma to treat for the surrender. A capitulation was signed on the 10th of March 1585, the garrison retired, and the inhabitants submitted to Spain. The same causes produced the same effects a few weeks afterwards in the city of Mechlin and the smaller fortified town of Brabant; and thus, Maestricht having been captured five years before, the whole of the ten southern provinces of the Netherlands, except the city of Antwerp, were subjected, after a most vehement struggle of twenty years' duration, to their former cruel and intolerant sovereign.

As the siege and capture of Antwerp was in its day considered as the most important military occurrence of the age, the history of its progress merits a detailed notice. The city of Antwerp stands upon the right bank of the river Scheldt. The stream is deep and the tides are rapid, so that the largest vessels could approach its banks.

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Below the city the river divides into several large branches or arms, and thus forms the islands which compose the province of Zealand, by which there are safe communications by water with the several towns of that province, which was then in the possession of the Dutch. These towns were filled with seamen, and they were in possession of powerful naval armaments, and of arsenals where other vessels could be equipped with facility. They also contained abundance of storehouses filled with all the implements of war, and others provided with necessary articles for subsistence, such as were indispensable in a large city when in a state of siege. The mouth of this river on both sides was commanded by powerful forts in the hands of the friends of the defenders of the city, but which at the commencement of the siege were taken by the assailants. By the possession of Ghent, which the Spaniards had gained soon after the commencement of the siege, and of the other strong places near the upper part of the river, no means of relieving the besieged could be drawn from that quarter ; but supplies, which were conveyed by the Scheldt from Friesland, forbade the expectation that by means of famine the city could ever be compelled to surrender. The extent of the works surrounding the city, the strength of the citadel that commanded it, the number of men under arms within it, and especially the tried courage, skill, and inflexibility of the commander, whom Prince Maurice of Orange, the successor of the assassinated prince, had recommended, rendered inoperative all the efforts on land to reduce the place.

The commander was Philippe de Marnix, lord of St Aldegonde, and generally known by that name ; he was the intimate confidant of William, and one of those who opened the first scene of the opposition to the tyrannical measures of the king of Spain.

The Duke of Parma soon saw that, in spite of the forts which he had erected on the banks of the river, the vessels from Friesland, laden with provisions, could with little risk, when favoured by the rapid tide and a good breeze, pass to the city and return with very little or no injury. He then conceived and planned the execution of a bridge over the stream, at a bend of the river near to Lillo and Liefenschoeck ; and thus, by shutting up the passage, hoped to reduce the city by famine. At the spot selected, the breadth of the stream is 2400 feet, or about half a mile. The execution of this work was intrusted to a celebrated Italian engineer named Barroccio, who had been sent by King Philip for the purpose, as soon as the project of the duke had been communicated to him ; a man well calculated to carry into effect the great project which Parma had originally formed in his own mind, without intimation from any of the general officers, many of whom opposed his views, as being impracticable. The first steps were the erecting of two strong forts on the opposite sides of the river, and then throwing forward two piers from each side, which were to correspond in the middle when half the waterway was closed. The piers were formed of stakes driven firmly into the bed of the river, and rested on hard sand below the mud ; and they were cemented with masses of earth and stones, and, when at a proper height, were covered with planks, and defended by parapets, on which cannon were mounted.

The vacancy between the termination of the two piers was filled up by a bridge of boats fastened together by chains, and secured by anchors. They were thus moored so as to yield to the rising and falling of the tide, and were armed with a great number of cannon. For the construction of this work, almost all the labour of the country was put in requisition. Carpenters, shipwrights, smiths, and even masons, were all compelled to work at this erection ; whilst great numbers of other men were employed in cutting down the trees in the neighbouring district of Waaslande to furnish materials. Heavy contributions were extorted from every part under the Spanish authority ; and thus, as neither money nor labour was spared, a few months were sufficient to complete the bridge, which was twelve feet in breadth, so that eight men could march abreast, and were under the protection of wooden bulwarks, which were musket-proof.

But the work was not suffered to proceed without some interruptions. The Antwerpers burned some and captured others of the boats on which the bridge was to be erected, and many vessels succeeded in forcing their passage through the unfinished bridge, and conveyed cargoes of provisions to the besieged. Some of these, however, being captured, orders were issued in Zealand that no single ship should attempt to force a passage, but should wait till a fleet had been collected, to proceed in concert. By way of creating a diversion in favour of the besieged, an attempt was made by the Frieslanders under Prince Hohenlohe to seize the city of Bois-le-Duc, then garrisoned by Spaniards ; but though at first successful, the ultimate issue was a repulse, with considerable loss of life to the Frieslanders.

The approach of winter caused the Spaniards some apprehension for the fate of their yet unfinished work, and for a time totally suspended it ; and when the frost broke up, some fears were entertained that the great masses of ice brought down from the upper part of the river might carry away the works by their weight ; but fortunately the larger bodies of ice grounded near the piles, and melting there, caused little or no damage. When the ice had thus been removed, the work was completed, and the entrance closed. Other contrivances were adopted to impede the passage of ships, especially some rafts, composed of thirty vessels loaded with ballast, and armed with sharp iron points to entangle vessels attempting to ascend.

This prodigious work, which required six months to complete, so securely barred the entrance of provisions and stores from Zealand, that the destruction of it required the most sedulous exertions of the besieged ; and efforts were immediately commenced to effect that object. An Italian by birth, but who had been long established in Antwerp, named Giambelli, had intrusted to him the construction of the engines to destroy the bridge, and to open a passage for a fleet loaded with provisions which had been prepared in Zealand.

The consternation excited in Antwerp at the prospect of the completion of the bridge was so great, that when known it was considered as the operation of the Evil Spirit ; but that view soon gave way to a firm resolution to counteract this work of the demons. Giambelli, being skilful as a fire-worker as well as an engineer, determined, by means of explosion and mining, to destroy the bridge. To effect his purpose, he required three of the largest ships lying at Antwerp to be used as mines, and sixty smaller and flat-bottomed vessels to be converted into fire-ships ; but motives of economy had such weight with the inhabitants, that he was compelled to contract the plan of his operations. He could only prevail on the council to give him two ships, and those of small size, and thirty-two flat-bottomed barges. The mining-ships had a magazine built of masonry three feet in height, the same in breadth, and sixty feet in length, to be filled with gunpowder. It was covered with a roof formed of mill and other hard stones, six feet in thickness, that by its weight the explosion should take effect in a sideway direction. These mines were charged with between six and seven thousand pounds of the finest gunpowder, and between it and the roof was laid a vast quantity of stones, iron bars, and all such other pieces of iron as could be most easily got together. Through a hole in the mine, a due quantity of match to ignite it was introduced. The whole was on the outside so finished as to have the appearance of only a common fire-ship. The interior of the mining-ships were furnished with mechanical clock-work, by which, when the hand reached a certain point, it would move a spring connected with a musket-lock, by which the match would kindle, and the explosion would be produced. The flat-bottomed vessels were filled with combustibles to act as fire-ships, as the destruction of the bridge was to depend on the mines; but these were thought necessary to hide the main design of destroying the bridge by the floating volcanoes, and to attract the attention of the enemy's artillery whilst the volcanoes were getting to their proper station. This formidable fleet, on the 4th of April, at the close of the day, departed from Antwerp, at the moment of the first reflux of the tide. First proceeded a small fire-boat, then the thirty-two fire-ships, in four tiers of eight each, fastened together with chains. The two floating-mines closed the squadron. The direction of the vessels was intrusted to a number of boats, well manned with rowers, by which means the whole was brought into and kept in the middle of the stream.

The report of some great intended effort of the besieged had been spread in the Spanish army, and proper measures of watchfulness were adopted, by strengthening the guards on the forts, on the banks of the river, and on the bridge, so that, at the first appearance of the squadron, each corps was at its proper post, waiting tranquilly the approach of the enemy. The outposts on the river first observed the fire-boat in flames, and then the others appeared with their burning fires, hiding the mining vessels in their rear. Every man was quickly in motion. The whole bridge, from one end to the other, was crowded with troops, as well as the forts at each end of it, and the batteries on both shores; and each gunner stood with his linstock ready to discharge the cannon. The Duke of Parma was himself present giving his orders, and observing the astonishing spectacle. Not only the combustibles in the vessels, but the vessels themselves, appeared to be in flames. The stream was illuminated, and the bank blazed with the reflection. The squadron had approached to within two thousand feet of the bridge, when the preparation of the mines was completed, and the boats that had towed them cut off and removed to a distance to wait the expected explosion. The squadron, thus too early left to the sole direction of the tide, was drifted in different directions. Some of the fire-ships got on shoals, and there burned out without doing any mischief; the smallest of the two mines got on shore, sprung a leak, and sunk; others of the fire-ships became entangled in the floating vessels, and burnt themselves out. All danger seemed to the Spaniards to be over, and they enjoyed their jests at the expense of those who had expended so much time, labour, and money, so ineffectually. In a few minutes, however, the largest of the mining-ships descended the stream, and fell on the bridge on the Flemish side, near to where the pier terminated in the fort. The duke was standing near it, and, urged by a young officer who had been an engineer, and knew the skill of Giambelli, to retire from the spot on which he stood, he refused to do so, when the young man seized him by the cloak and pulled him away. At that moment the great magazine exploded. The report and the shock were tremendous. Even the bottom of the river was turned up by its force, and rushed with impetuosity over the banks. A concussion of the earth, resembling an earthquake, was felt over a circle of ten miles. The contents of the floating volcano, mingled with the ruins of the bridge, with shot, weapons, and the bodies of soldiers and sailors, were blown to an invisible height in the air, and in their fall were scattered over so vast an extent, that scarcely any particle of what they had been was distinguishable. The Duke of Parma with his staff-officers were thrown down senseless, and himself severely wounded by one of the beams, which was forced between his head and his shoulders. The Marquis of Richebourg, with two other superior officers, Roubais and Billi, near him, were killed, and more than 800 soldiers perished. The casualties were produced, some by the flood, others by flames; and the fragments of their bodies were scattered far and wide.

When the duke had recovered from his fainting, he immediately gave directions to repair in some degree the damage which his works had sustained. In the night when the explosion took place, and the following day, expectation was alive, in both the opposing forces, for the appearance of the Zealand fleet, to the progress of which the remains of the bridge would have been no obstacle. By some want of combination, that fleet was detained, and the prince inspired those under his command with so much energy, that, directing their united powers to one object, they were enabled, by sinking boats and vessels in the open places, by driving piles, and by fastening chains, to oppose such powerful impediments as prevented the Zealanders from attempting to force the passage up to Antwerp.

The besieged, although thus disappointed, did not give way to despair. Giambelli prepared another floating mine, to which was given the presumptuous name of the End of the War; but this machine grounded in descending the stream, and was destroyed without producing any effect on the enemy. There was one resource left to the besieged, which was recommended by the example of the siege of Leyden, where it had been attended with success. It was that of inundating the whole country between Lillo and Stabroch, including the Spanish camp at Bevern. In order to accomplish this, it was necessary to cut through the dike or bank which defended it against the irruption of the Eastern Scheldt. The whole plain intended to be covered with water was traversed by a high and wide counter-dike, called the Dike of Couvestien; and the Duke of Parma, knowing its importance, had early taken possession of it, and had protected it by several strong forts. The garrison, aided by the Zealanders, made two spirited attacks on this series of works, in the latter of which the blood of both parties was most profusely shed. Each fought with the most desperate valour; but finally the confederates were repulsed, leaving three thousand dead upon the dike, or at its base, and the Spaniards lost more than eight hundred men. The unsuccessful issue of these several efforts had its effect on the population of Antwerp. The scarcity of provisions already felt, and the prospect of the famine which evidently impended, made some clamorous and most anxious for peace. This disposition led to negotiations for surrender, and the commander Aldegonde himself repaired to the camp of Parma to open a treaty; but the duke would not listen to the terms proposed, which required an amnesty for all past transactions, and permission to the Protestants to be allowed to follow their own religious opinions. Other negotiations followed, and, whilst they were depending, the surrender of Mechlin to the Spaniards cut off the little hope of a supply of provisions which had hitherto existed. The clamours of the inhabitants became so loud, that the council and the commander were compelled to yield: they proceeded in a body to the Spanish camp, and there, after a close siege of fourteen months' duration, a capitulation was signed on the 17th of August 1585. The terms of it were, that the city should submit itself to the king of Spain in his character of Duke of Brabant; that all past events should be forgotten; that the Catholic religion alone should be exercised, and that those of other persuasions be allowed four years to dispose of their property and withdraw; that the churches should be rebuilt at the expense of the citizens, who were also to present to the Spanish army 400,000 ducats (about L.38,000), and, as long as Holland continued in a state of hostility with Spain,

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to maintain a garrison of 2000 men. Aldegonde, the commander, was also, by the terms of the treaty, prohibited from bearing arms against Spain for one year.

The capture of Antwerp was one of those important events the consequences of which became of less weight as time advanced; but these consequences were ultimately more in favour of the vanquished than of the triumphant party. Both parties had been weakened by the long contests which had been carried on; and both had nearly exhausted their powers in the struggle, which left them in such a state that a great degree of inactivity prevailed. Spain had acquired in the ten provinces a full authority, which no exertions on their part could shake off. The united provinces had also secured their independence and self-government, and, from the nature of their country, and the adaptation thereto of their naval power, were enabled to bid defiance to any attempts made to subjugate them to the power of Spain.

At this period the warlike operations between what may be called Holland and Belgium had been suspended, because in the latter country no resources were left to the government, and no aid was sent by King Philip, who was hindered from doing so by his treasures being required to secure the acquisition he had lately made of the kingdom of Portugal, and by the expenditure he applied to the equipment of that force destined for the conquest of England which had been pompously styled the invincible armada.

Some contemporary authors have assigned another cause of Philip's withholding supplies to the Netherlands, namely, a jealousy of the Duke of Parma, which led that suspicious monarch to apprehend that, seeing Belgium to be of far greater value than his dominions in Italy, feeling his own great popularity, and observing the general hatred of the Spaniards, he might be induced to assume for himself the sovereignty.

The capture of Antwerp, though celebrated with most extraordinary demonstrations of joy in all parts of the ten provinces, was to them only the consummation of that misery and depression under which they had so long suffered. That city had been the focal point to which the commerce which enriched the country had been attracted. In the hands of the Spaniards, it was closed from the sea by the Dutch being in possession of the mouth of the river on both sides. The disputes about religion, which had distracted the two opposing parties, were quieted by the absence of the Protestant portion of the merchants and manufacturers, who carried with them what could be obtained for their fixed capital, and directed their fluctuating and scattered funds to be transmitted to the places to which they had removed. Amsterdam rose, with a rapidity hitherto unknown, to be a vast commercial place; the other towns in Holland shared in the advantage; and much of it was imported into London, Hamburg, and other foreign cities.

According to Schiller, the reconciled provinces in the interior exhibited the most deplorable spectacle. The inhabitants of the great towns had in a great measure fallen victims to the united calamities of war, pestilence, and famine. Large villages, which once contained from two to three thousand inhabitants, were absolutely abandoned to the wolves, who had become so numerous and fierce that they attacked not merely decrepit persons and children, but strong and full-grown men; the dogs, driven about by hunger, had become as ferocious as other beasts of prey, and joined in large packs in hunting down cattle and men; neither fields, nor woods, nor roads were to be distinguished by any visible boundaries; all was an entangled mass of trees, weeds, and grass; so that many who returned to take possession of their property could not find out the places where their dwellings and fields had been. The prices of the necessaries of life were so high, that persons of rank were compelled to dispose of whatever they had to buy bread, and were often so reduced as to have recourse to open beggary in the streets; whilst the poorer classes could only sustain life by food of the worst and most unhealthy description. Few marriages were contracted, few children born, and of these a great proportion were early carried off by death.

Although more properly belonging to an account of Holland, we cannot omit to remark the great contrast between that country and Belgium at this particular conjuncture. There the pecuniary contributions were extorted to a greater extent, and with equal severity. There, by the increase of their shipping, no scarcity nor any great enhancement of the prices of corn had been felt, as their supply was copiously obtained from the shores of the Baltic; and the extension of the fisheries supplied them amply with that kind of food, whilst within the dikes the rich meadows yielded abundance of butter, cheese, and pork, with some other kinds of meal. The heavy contributions for defence, as well as the means of subsistence, were almost exclusively met by the rapid increase of a profitable commerce. Their vessels sailed freely to the British kingdoms, to the Baltic ports, to Italy, and even to the harbours of their enemy, King Philip, both in Spain and in Portugal. The trade between the last-mentioned countries and their settlements in Asia and America was rather in the hands of foreigners than of natives, the Spanish houses of commerce scarcely giving more than their names to the transactions. The Hollanders partook largely of this trade; their manufactures and their cured herrings were much sought after, and gave them an enormous profit; and though the trade was pronounced contraband by the Spanish king, it could not be prevented; for, in spite of his ordonnances, it was so profitable to both parties, that Dutch ships under Hamburg or Lubeck colours were to be seen in all the ports of the Peninsula. By these and by other means the linens of Holland were to be seen in all the shops of Mexico, Brazil, and Peru, the payment for which, besides the tropical productions, brought gold and silver, coined or uncoined.

The religious dissensions of the period here referred to gave rise to that formation of national character which has since distinguished the two countries. The Belgians, in their severe sufferings, attributed them all to the part which the Protestants had taken in the first opposition to their Spanish king. This begat hatred to the reformed religion, and as their priests did not fail to impress that feeling, it was natural that augmented suffering should give it a more intense bitterness. It is not therefore wonderful that the hatred of the Belgians should have naturally grown, as it manifestly has done, to a degree of bigotry in religious matters, which could not be much lessened by the attempt made two centuries later to form the two parts into one kingdom under a Protestant prince. The Hollanders, on the other hand, gradually became as rigidly attached to the religion which they had embraced. It was naturally associated in their minds with all the privations which they had at first endured, with the victories they had afterwards gained, with the independence they had accomplished, and with the flourishing state of the commerce they had acquired. The emigrants, too, who joined them from Antwerp, Ghent, Brussels, and the other places which had capitulated under the condition that the Protestants should have time and permission to remove with their property, felt themselves to be suffering banishment for their religion, and as martyrs became more zealous in their adherence to the cause for which they had suffered. The Dutch did not, like the Belgians, proscribe the adherents of the opposite religion, but granted them permission to indulge in their own faith and ceremonies. This was, however, more owing to the indifference of the princes of the house of Orange on these subjects, and their views of the political and commercial benefits of toleration, than to the absence of bigotry amongst the Dutch people and their clergy. Very soon after their independence was universally acknowledged, the states showed quite as much bigotry towards the professors of the Protestant religion who differed on incomprehensible subjects with each other, as had ever been exhibited by any Catholics in behalf of the rites, ceremonies, and dogmas of their more magnificent church.

Besides the difference of character between the people of these two portions of the Netherlands, there was a great dissimilarity in their manners and domestic habits, which may be the more properly noticed here, because its operation has been continually active during the attempt made in the present day to consolidate into one body politic the two nations, and because the attempt has altogether failed.

The southern or the ten provinces had grown up to be a great commercial, manufacturing, and agricultural community. Each of these branches, acting upon the other, had created that general prosperity which naturally leads to the indulgence of hospitality, of jovial intercourse, and the enjoyment of luxuries of various kinds, according to the relative state of the parties composing the community. The fat burghers of Ghent and of Bruges, and the farmers of Flanders with their ornamented strong horses, and their bedizened spouses, with their ear-rings of silver or gold, were sometimes objects of ridicule and sometimes of envy to the other people of Europe. Though not very ready to pay taxes to their princes, they were always prepared to spend with cheerfulness on their own gratifications, and in hospitality to their friends. Even the peasantry were merry and cheerful in their village dances and their rural festivals, which some of the best artists have painted, and made visible to subsequent ages by their unperishing works. In short, if the people of Flanders were not profuse, they were not rigidly economical. Some of the profits of the different branches of industry were undoubtedly saved and added to the capital; but a considerable portion was expended in gratifying the tastes for show, conveniencies, a cheering table, and good strong beer. The Northern Netherlands, at the period when the troubles began, were generally in a state of great poverty. Their trade was inconsiderable, and their rural industry chiefly confined to the dairy. The nature of the country recovered from the water, and protected by strong embankments from being again flooded, required all the labour and all the revenue that could be collected. The only way in which the population could subsist was by the practice of the most severe parsimony in their dwellings, their food, and their clothing. When the war commenced, they began to bestir themselves in the fisheries and the foreign trade. The profits of this were slow in arriving, and thus the habit of frugality was strengthened; and, when the profit did arrive, so large a portion was required for the general defence that none could prudently be devoted to purposes of luxury or splendour. Whilst extravagance was wisely forbidden, it is generally thought that hospitality disappeared. The domestic enjoyments were unsocial, and, except the practice of extreme cleanliness, little engaged the attention of the families but the saving of money. This representation of the national character of the Dutch has been generally dwelt upon with more severity than it deserves; but it was necessary in the circumstances, in which a tone was given to manners and morals, which has been more or less strictly adhered to till the present time. The emigrants who came to them from the southern division were at first compelled, by the losses they had suffered, to practise the same parsimony as the former residents. They too, therefore, at first from necessity, and at length from principle or habit, became, equally with the others, habitually parsimonious and economical. It has been deemed proper to notice in this place the growth and difference of national character between the Dutch and the Belgians, because it will tend to throw some light on the most recent transactions which have taken place relative to those countries.

Although Parma, after the conquest of Antwerp, did all in his power to conciliate the inhabitants, and to relieve the distress to which they were reduced, he could only succeed with the Catholic portion of the population. The Protestants almost all left the country within the period allotted to them. The merchants removed to Amsterdam, and the manufacturers to Haerlem and other towns in Holland; and some of them repaired to England, and to the towns of the Hanseatic League on the Continent. Whatever projects the duke may have formed to relieve the pressure on the people under his command, they were all soon suspended in order to assist in the grand operation of King Philip to invade and conquer England by his invincible armada. Whilst that armament was preparing in Spain, and employing all the treasures of the monarchy, Parma, with no other resources but such as he could draw from the impoverished Flemings, was enabled, by his vigour, to fit out and arm a very powerful flotilla of vessels calculated for the conveyance of troops, and to man them with sailors better adapted for the stormy seas of the north than the Spaniards and Portuguese who manned the ships of the grand armada which had sailed from Lisbon. The Belgian fleet was collected in the Scheldt, and when completed found itself blockaded there by a Dutch naval force under the grand pensioner De Witt, and by the forts constructed at the mouth of the river, which were held by Zealanders. The flotilla was then ordered to ascend the river to Ghent, and from thence to be conveyed, either by old canals deepened for the occasion, or by new canals constructed on purpose, or by land carriage, to the small streams of the Lise, the Moere, and the Yperlee, which run to the ocean near Nieuport. They waited there for the arrival of the armada, whilst the ships of war which were destined to protect them were in the harbour of Dunkirk. The Hollanders, then, by a series of admirable manœuvres, under Justin de Nassau, so managed, that, with a fleet of ninety sail of temporary armed vessels, they closed up every opening to the sea from the mouth of the Scheldt to Dunkirk. When the Duke of Parma arrived at Dunkirk to embark, he discovered the impediment, and found the exertions he had made all rendered fruitless. The Spanish armada was then in the strait between Dover and Calais; the commander, the Duke of Medina Sidonia, was in difficulties, as the project was that Parma should land an army from his flotilla, and seize upon London, then without defence. Medina Sidonia's fleet had been weakened by the various and spirited attacks made on it in the passage up the British Channel, and he had lost some of his ships. Near Calais one large galleon was taken by Sir Francis Drake, and the ship of Admiral D'Ocquendo was burned; and the Spanish fleet, which could obtain no succour from the Flemings, began to feel a scarcity of provisions. It was at anchor near Calais when six fire-ships were equipped by Giambelli, the engineer who had directed the operations at Antwerp, and who was now in the service of Queen Elizabeth. These were kindled, and at two in the morning, with the wind and tide in their favour, despatched towards the Spanish fleet. The Spaniards, who had seen the infernal machines of Giambelli before Antwerp, thought these vessels were of the same description, and spread consternation around them by the cries and shouting, "The fires of Antwerp." In the terror, many of the ships cut their cables and fled before the wind, to avoid the flames of the fire-ships.

The result of the Spanish expedition belongs to the history of that country or of England; but the efforts of preparation made in the Netherlands pressed with more weight on that country than many of their sacrifices during the war, and the consequences were longer complained of.

The wars in France between the Catholics and the Protestants engaged the attention of the Duke of Parma, and some of the Flemish troops aided the cause of the former, especially in raising the siege of Rouen. He was about to send a more considerable expedition into that country, and had proceeded as far as Arras, in the abbey of which city he died, after a short illness, on the 3d of December 1592, in the forty-fifth year of his age. After the termination of the siege of Antwerp, he had sedulously attended to the interests of the dominions retained by Spain. Agriculture was supported, and domestic manufactures were encouraged; the taxes were lightened; and in the seven years that passed between the surrender of Antwerp and the death of Parma, a visible improvement had taken place in the appearance of the country. It had been freed from civil war, and almost secured from invasion; the power of the law was so far restored as to give security to property, and thus promote industry; and, though warlike expeditions were undertaken, the troops only acted as auxiliaries, and were not maintained from the resources of Belgium, but drew their supplies from the countries in which they served.

The Duke of Parma had been intrusted by King Philip with power to name his successor, and, foreseeing his death, he had appointed the archduke, Pierre-Ernest Count of Mansfeldt, a younger son of the emperor of Germany. The army, which had been before prepared, was led by him into France, and there signalised itself by the assistance which it afforded to the party of the league. He did not return to Belgium till January 1594. During his absence domestic tranquillity prevailed, though in the interval the Dutch, who had chosen Prince Maurice to succeed William of Orange, had captured the towns within the seven united provinces which were held by Spanish garrisons. These were, Deventer, Zutphen, Groll, Breda, Nimwegen, Gertrudenburg, and Steenwyk; and they formed a powerful barrier against any attempts that could be made by the troops of Spain in Belgium.

The archduke, obtaining no remittances from Spain, made application to the states of Holland for entering into a pacific negotiation with them, and addressed his letter to the states, which, by implication, was an acknowledgment of their sovereignty. Commissioners from both parties met; but about that time the Dutch had discovered some attempts at a plot for the assassination of their stadtholder, Prince Maurice, his brother Prince Henry, the pensioner Oldenbarnevelt, the chancellor Leoninus, and the general Aldegonde. A priest of Namur having been taken disguised as a soldier, had confessed the criminal design, and named his accomplices. The suspicion excited by this discovery was strengthened by that of another project to be executed in England by a Portuguese physician against the life of Queen Elizabeth. The Dutch would not trust to Spain. The archduke was assured by them, and in most courteous terms, that they could not trust to any terms which Spain could nullify by changing their governor of the Netherlands; but they were willing to treat, and wished to be at peace with the Catholic provinces. The archduke was mortified at the rejection of his offers, and other vexations arose from the withholding pecuniary supplies by Spain, so that when the army returned from France their arrears could not be paid, and they mutinied and ravaged the province of Hainault. At the same period the news arrived that Henry IV., who had been reconciled to the church of Rome, and was peaceably seated on the throne of France, had just declared war against Spain. These troubles, with others created by his aspiring to the French sceptre, so affected the health of the archduke, that after a short sickness he died at Brussels in February 1595.

He was succeeded in authority by Count Fuentes, who, as a military man of approved exertion, raised two armies, one to defend the frontier against the Dutch, and another for the purpose of invading France. On the side of Holland little was done, both parties watching each other without coming to any decisive action. On the side of France, whilst the army of that country entered Hainault, the force under Fuentes attacked the fertile episcopal state of Cambray, and after a spirited siege took the capital city. But the vice-regency of Fuentes was of short duration; for in the beginning of the next year the Archduke Albert was appointed governor, and arrived at Brussels, bringing with him the Prince of Orange, the eldest son of William the Silent, who had been carried away when Count of Beuren in 1568, and kept as a prisoner in Spain during the whole period of the glorious achievements of his father.

This archduke was the fifth son of the Emperor Maximilian II., and nephew of Philip, by whom he had been educated, and whose good opinion he had gained by his prudence and valour whilst acting as viceroy in Portugal. Philip had designed him to be the husband of his daughter Isabella, and intended to create the provinces of the Netherlands into a sovereignty under his command. He was sent, in the character of governor-general, to prepare the inhabitants for this change, by conciliating the Flemings. Albert brought with him large pecuniary supplies, which enabled him to continue the warlike operations against France under the conduct of his predecessor Fuentes. In this he was in some measure successful, as he was enabled to capture Calais, and to avoid a pitched battle with Henry IV. king of France, who commanded his army in person. Whilst engaged in these operations, he attempted to enter into some negotiations with the view to a reconciliation with the Dutch; but the latter would not trust to the sincerity of Spain. Though the Prince of Orange made some efforts, his principles were doubtful; and, from the court and country in which his mind had been formed, they objected to his visiting Holland. Civil communications took place, but no progress towards conciliation was made, and the prince continued to reside in Brussels in a state of inactivity till his death.

The attempt of the archduke to draw the Dutch into a negotiation by the instrumentality of the Prince of Orange having failed, he was induced to prepare an army of 6000 men for the invasion of Holland; but his general, Varas, was out-manœuvred by Prince Maurice, who met him at Turnhout on the 24th of January 1597, and, with very little loss on his part, obtained a most decisive victory, dispersing the Belgians, and capturing the whole of their artillery, stores, and baggage, with many prisoners. This was the last considerable battle between the armies of the two divisions of the Netherlands. The effect of this discomfiture to Belgium was serious, inasmuch as it disorganized the army and deranged the finances, whilst it increased the strength, and still more the confidence, of their opponents.

Philip of Spain, who now felt his end approaching, became desirous of putting an end to the war with France, and also of establishing a general peace. At first the negotiation comprehended the states of Holland; but, in May 1598, a peace was concluded which did not extend to them. In a few days after, a public communication was made, that the sovereignty of Burgundy and the Netherlands had been transferred from the crown of Spain to the Archduke Albert and the Infanta Isabella on their being betrothed, a ceremony which was performed by proxy on the part of the Infanta, who was still in Spain; after which he was solemnly inaugurated at Brussels on the 22d of August. He immediately departed for Spain to complete the marriage, and left the government of his newly-acquired dominions in the hands of his brother, the Cardinal Andrew of Austria, but placed the troops, which amounted to 22,000 men, under the command of Mendoza, a Spaniard. As the archduke travelled slowly, he was nearly six months before he reached Valencia in Spain, where the marriage was consummated, and where soon afterwards he received the intelligence of the death of King Philip, the father of his bride; but it was then nearly six months more before the archduke and archduchess arrived in the city of Brussels.

In this year Mendoza, on the pretence of invading Holland, led his army into the duchy of Cleves, and some of the neutral states in Westphalia, where the most atrocious cruelties were exercised and the most extensive devastations practised. They were, however, in some degree checked by Prince Maurice with a much inferior force, and prevented from passing the Dutch frontiers. The Germans, roused by their country being invaded, hastily mustered an army of 14,000 men, badly disciplined and equipped. Mendoza resolved to abandon his projected invasion of Holland, and encounter the advancing Germans under the Count de Lippe. In an action fought with these Germans, Mendoza was eminently successful; with the loss of a few men, he was enabled to gain a victory, by which his opponents, if not destroyed, were completely dispersed.

These transactions kindled anew the patriotic spirit of the Hollanders, which from inactivity had begun to languish, and which had also been checked by the heavy taxes imposed on them, and by the demand of Queen Elizabeth for payment of the supplies she had afforded them, accompanied with the orders for the recall of her troops.

But Prince Maurice knew how to inspire the Dutch with energy, and he obtained some auxiliary troops from other countries. He had some Germans, some Swiss sent by France, and troops both from England and Scotland, then separate kingdoms; and he collected the whole disposable force of the Dutch confederacy, amounting to about 17,000 men, whom he secretly transferred to the island of Walcheren, and having plenty of craft adapted to the purpose, he suddenly shipped them, and ascended the river Scheldt. He passed with the rapid flood-tide the city of Antwerp, and was in hopes of surprising Ghent, where he had calculated on finding a party disposed to assist him. In this, however, he was disappointed; and taking possession of some forts in the vicinity of that city and of Bruges, he advanced to Nieuport, the siege of which place he immediately commenced.

The archduke was taken by surprise, and the Spanish forces were in a state of mutiny on account of their pay being in arrear. In this crisis he acted with great decision and celerity, and in a few days was able to collect a force of 12,000 men, which assembled at Ghent. Nieuport, which Maurice was besieging, is on the sea-coast, amongst the downs or sand-hills, and in a country affording but scanty supplies. The first movement of the archduke was to cut off the retreat of the Hollanders, in which he was favoured by the occupation of Ghent and Bruges. He also determined on raising the siege of Nieuport, and recaptured all the forts which Maurice had taken, except those of Ostend. As he advanced he came in contact with a part of the army of the Dutch, consisting of 3000 men, commanded by Prince Ernest of Nassau, and composed for the most part of Scottish infantry. These were attacked, and, to give time to the main body under Maurice to form, they fought most gallantly; but, after a loss of nearly one third of their number, and being completely separated from the rest of their army, they were defeated, and at length threw themselves into Ostend. The archduke, encouraged by this success, resolved to attack Prince Maurice. Most of his more experienced and cautious officers recommended that the army should remain in their position, where, by famine, they would shortly compel their opponents to surrender. Others, especially the Spanish officers, elated by their recent success, urged an immediate advance. Maurice, who had been surprised by the rapid movements of the enemy, was in a most embarrassing situation. Before him was the garrisoned town of his enemy, and behind him the main army, now more than equal to his own in numbers, as well as in courage and discipline. The sea was open to him, and such was his alarm, that he desired his brother, Prince Frederick Henry, and a young prince of Holstein, with several young English nobles, who were volunteers, to embark on board a vessel; but they all refused, and resolved to face the threatened battle; and, as Maurice could not embark his whole army on an open shore in the face of a superior force, he determined to risk an action in which he had little cause to hope for a victory. It was the resolution of despair rather than of hope. The vessels on the coast were ordered to depart and range themselves before the port of Ostend.

It has been remarked by the historians of the day, Vandervynk and Grotius (the latter of whom, then a youth of eighteen, was present), that each of the armies was of such a variety of troops as to make them respectively an epitome of the various nations of Europe. The force of Maurice consisted of Dutch, English, Scotch, Germans, French, and Swiss, under Count Louis of Nassau, Sir Francis Vere, Sir Horace Vere, and other English officers of considerable celebrity. The archduke had under his command Spaniards, Italians, Walloons, Belgians, and Irish, who were led by Mendoza, La Berlotta, and other celebrated officers. The rival generals rode along their respective lines, addressed a few words of encouragement to their men, and the contest commenced.

On the 2d of July 1600, at three o'clock, the archduke began the attack. His advanced guard, commanded by Mendoza, and composed of the mutineers, who now resolved to atone for their former misconduct, marched across the sand-hills with desperate resolution. They soon came into contact with the English part of the force under Sir Francis Vere, who was desperately wounded in the first shock. The assault was almost irresistible. The English, borne down by numbers, were forced to give way; but the main body pressed on to their support, and Sir Horace Vere stepped forward to supply the place of his brother. Not an inch of ground was gained or lost; the firing ceased, and pikes and swords crossed each other in the regular conflict of man to man. The action now became general along the whole line. The two commanders-in-chief were to be seen at all points. Nothing could exceed their mutual display of skill and courage. At length the Spanish cavalry, broken by the well-directed fire of the patriot artillery, fell back on their infantry and threw it into confusion. At the same instant the archduke was wounded by a lance in the cheek, unhorsed, and forced to quit the field. The report of his death, and the sight of his war-steed galloping alone across the field, spread alarm throughout the royalist ranks. Prince Maurice saw and seized on the critical moment. He who had so patiently maintained his position for three hours of desperate conflict, now discerned the instant for a prompt and general advance. He gave the word, and having led his troops to the charge, the victory was at length decided.

The defeat of the royalist army was in fact complete. The whole of the artillery, baggage, standards, and ammunition, fell into the hands of the conquerors. Night alone saved those who fled, and the nature of the ground prevented the cavalry from consummating the destruction of the beaten army. Accounts differ as to the actual number of the killed, some stating it at 6000 men, others at

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3000; but perhaps the latter computation does not include the wounded. For the number of men engaged, it was the most bloody battle that had yet been fought. All agree that more than half of the men engaged on both sides were either killed or desperately wounded. The Hollanders alone made prisoners, and amongst them were many officers of the first rank. Mendoza was one of these; he had been wounded, and the prince had difficulty in saving his life from the German auxiliaries, who were desirous of revenging on him the atrocities committed by his army in the duchy of Cleves and in Westphalia. Amongst the other prisoners of eminence were the admiral of Aragon, the seneschal of Montemilard, and the generals Don Louis de Vellar, Don Idiaquez Monroy, D'Avila, and the aide-de-camps of the archduke. The archduke, furnished with a fresh horse, made his escape from the field, and reached Bruges, where he joined his wife, who had confidently expected him to return victorious, and immediately proceeded to Brussels. Although wounded, and at one time a prisoner, but rescued by his own troops, he uniformly preserved his presence of mind, and throughout gave such directions and orders as evinced the soundest judgment.

This bloody victory was of little military consequence, but the moral effect on the courage of the conquerors, and in the depression of the defeated, was of the greatest importance. Prince Maurice had escaped from a destruction that appeared almost inevitable. After the battle he resumed the siege of Nieuport; but some reinforcements had been introduced, which rendered its speedy capture impracticable, and, from want of supplies, the attempt was abandoned; and having prepared Ostend for a vigorous defence, he returned to Holland with the remains of his army. He was there received with the most rapturous congratulations by his countrymen; but amongst the more rigid of the republicans some jealousy arose, lest the successful soldier should aspire to be the sovereign of the country. This jealousy was felt by the pensionary Barnevelt, and, when extended, led to those agitations which long endured in the states, and which at a later period led to the death of that invaluable patriot; but these are transactions belonging exclusively to the history of Holland.

The archduke called together at Brussels the states of the Catholic provinces, who, when assembled, communicated their opinion, that nothing but peace would satisfy the inhabitants, or preserve the country from exhaustion and complete ruin. He could not but see the reasonableness of the view thus presented to him, and resolved to attempt a treaty. The states of Holland readily embraced the intimations made to them, and at length commissioners from both parties were nominated, and met at Bergen-op-Zoom; but their negotiations were broken off almost as soon as they had commenced. The Spanish deputies demanded that the new republicans should submit themselves to their ancient masters. But this was received by the deputies of Holland as worse than insult, and as a proof of the insincerity of those with whom it had originated, who must have known that such a proposition could never be permitted to become a subject of discussion. The parties soon separated, and during the winter that followed both made preparations for continuing the war.

Early in the spring, Maurice found himself at the head of an army of 16,000 men, composed chiefly of English and French, who, in this instance, cheerfully united and rivalled each other. He attacked the town of Rheinberg, and took it; but from before Bois-le-Duc he was obliged to retire. The whole attention of both the contending armies was drawn toward Ostend, a place of some though but little importance to either party, when put in comparison with the extraordinary loss of lives which the contest for its possession ultimately occasioned. The archduke, however, resolved on making the conquest of this place, and the Dutch seem to have made it a point of honour not to yield it up. The attack and the defence were carried on with equal skill, courage, and perseverance, and the operations, protracted for more than three years, kept alive the anxiety of all the military men of Europe during that period. Sir Francis Vere commanded in the place at the time of the first investment; but governors, garrisons, and besieging forces, were renewed and replaced with a rapidity which gave one of the most frightful instances of the ravages of war.

This siege became a school for the young nobility of all Europe, who repaired to the one party or the other to learn the principles and the practice of attack and defence. Every thing that the military skill of that age could devise was resorted to on either side. The slaughter in the various assaults, sorties, and bombardments, was enormous. Squadrons at sea gave a double interest to the land operations. The celebrated brothers, Frederick and Ambrose Spinola, founded their reputation on both elements. Frederick was, however, killed in one of the naval combats with the Dutch galleys, and Ambrose acquired his fame by the ultimate conquest of Ostend. As the Dutch had the superiority at sea, they could throw in renewed succours, whilst the Spaniards having full possession of the surrounding land, could bring to the besiegers whatever stores or recruits were needed. Redoubled attacks and multiplied mines at length reduced the town to a mere mass of ruins, and scarcely left to its undaunted garrison sufficient footing on which to prolong their desperate defence. Ostend at length surrendered on the 22d of September 1604, after a siege which had commenced in July 1601. The victors marched in over its crumbled walls and shattered batteries. Scarcely a vestige of the place remained beyond those terrible evidences of destruction. The ditches filled up with the rubbish of ramparts, bastions, and redoubts, left no distinct line of separation between the operations of attack and defence. It resembled a vast sepulchre rather than a ruined town, a mountain of earth and rubbish, without a single house in which the wretched remnant of the inhabitants could hide their heads.

The death of Queen Elizabeth of England happened during this siege, and some time was passed in anxious expectation of what would be the conduct of her successor, who was actuated on the one side by his high opinion of the rights of royalty, and on the other by the policy of his English ministers, and the representations of Henry IV. of France. In this case, though he threatened, he did not withdraw his troops from the Dutch; but he, at the same time, gave liberty to the Spaniards to raise recruits in England for the Belgic states.

In the year 1605, both the Dutch and the Belgians, the former under Prince Maurice, and the latter under Spinola, took the field. The prince projected the surprise of Antwerp; but the vigilance of Spinola anticipated his intention. Spinola then invaded the province of Overyssel, and took some of the smaller towns. Maurice flew to the relief of the province; and by his tactics obliged Spinola to retire to the Rhine, where he awaited at Roeroord the attack of the Dutch. A battle was there fought, in which the fortune of the day more than once varied. At length Maurice desisted, and the Spaniards had the honour of the victory; but the loss on both sides was nearly equal, and few or no prisoners were taken. In the mean time, the Dutch had gained a naval victory of much importance. A squadron of ships commanded by Hautain, admiral of Zealand, attacked a superior force of Spanish vessels close to Dover, and defeated them with considerable loss. The victory was, however, sullied by an act of great barbarity;

all the soldiers found on board the captured ships were tied two and two, and thrown into the sea. Some few extricated themselves, and by swimming reached the shore; and others were picked up by the English boats, the crews of which witnessed the scene, and hastened to the relief of the sufferers.

The military forces of the Catholic states had been abundantly supplied with pecuniary resources from the treasures of Spain. But Philip III. who had succeeded to the throne of that kingdom, found difficulties arise respecting the supplies. He wanted that economical arrangement in his finances which had been one of the peculiar features of the late king; he was embarrassed with troubles in Portugal, which showed strong dispositions to throw off the yoke of the Spanish government; and he had been prevented from drawing resources from his dominions in both the Indies, by the interruptions which the Dutch navy had caused in all parts of the world, and by the capture or destruction of some of his ships returning with the treasures of Mexico and Peru. Discontents had been created in the Catholic Netherlands, excited by suspicion of the design of Spain to place those states again under her immediate government. In one of his public rescripts, Philip had described the people of the Netherlands as *his beloved subjects*. This caused great agitation in the states, as they had imagined that the cession of the sovereignty to the archduke had made them an independent kingdom. The debts of the states had also accumulated to a large amount, and there was no prospect of discharging them as long as the war with the Hollanders should continue. Even the general, Spinola, had so encumbered himself with personal obligations to further the public service, that he gave a lead to the feeling generally entertained in favour of peace.

In this state of affairs, proposals were made by the archduke in May 1607, to enter into negotiations for a peace; and two plenipotentiaries having been despatched from Brussels, repaired to the Hague.

But public opinion in the Dutch states was much divided on this important question. An instinctive hatred against the Spaniards, and long habits of warfare, led the great mass of the people to consider any overture of peace as some wily artifice aimed at their religion and liberty. War seemed to have opened to them inexhaustible sources of wealth; whilst peace appeared to threaten the extinction of the trade, which was now as much a habit as war appeared to be a want. This reasoning was particularly convincing to Prince Maurice, whose fame, with a large portion of his authority and revenues, depended on the continuance of hostilities. It was also strongly relied on, and supported in Zealand, and in the chief towns, which dreaded the rivalry of Antwerp. Those who bore the burden of the war saw it, however, under a different aspect. They feared that the present state of things would lead to their conquest by the enemy, or to the ruin of their liberty by the growing power of Prince Maurice; and they hoped that peace would consolidate the republic, and cause the reduction of the debt, which already amounted to twenty-six millions of florins. This party was headed by Barnevelt, whose wisdom has been established by the issue.

The wish of that great man was for a suspension of arms, in order that opposition might subside, and the interests of the contending parties might be calmly discussed; and he managed so as to gain a reluctant acquiescence to his views from the Prince of Orange and his partisans. The united provinces positively refused to admit even the commencement of a negotiation until the archduke made a distinct recognition of their independence, and an ambassador was appointed with instructions to require this important admission. Some delay was occasioned by the demand for this preliminary, and many suspicions were either kindled or kept alive in the united states by the dubious tone of the Belgian authorities. These were, however, at length surmounted, and the independence of the states admitted in explicit terms, upon which a suspension of arms was agreed to for eight months. During this term of suspension the negotiation had nearly been suddenly broken off by the plenipotentiary of the archduke having attempted to bribe Aarsens, the greffier of the states-general. He was a monk, named Neyen, a native of Antwerp, and had several times passed between Brussels and the Hague, and had held private interviews with Maurice and Barnevelt. He took an opportunity to present Aarsens with a diamond of great value, and a bond of the archduke for 50,000 crowns, which was accepted and communicated to Prince Maurice, who, still anxious to prevent peace, hoped the rumour of this attempt would excite distrust, and break off the negotiation. But Barnevelt obtained the diamond and bond, and in the assembly handed them to one Verreiken, who had assisted Neyen, and read him a lecture of true republican severity. Verreiken was overwhelmed with shame, and Neyen was dismissed from the embassy; but, after this delay, the negotiation proceeded, in spite of the opposition of Prince Maurice and his adherents.

The assembly of ambassadors met at the Hague in January 1608, and though the plenipotentiaries of the archduke and of the Dutch states were the principal negotiators, yet the kings of England, France, and Spain had each their ministers, who interfered in the negotiations, and thereby created various obstacles, and many delays. The main points for discussion, on which depended the decision for peace or for war, were those which concerned religion, and the demand on the part of Spain, that the united provinces should renounce all claims to the navigation of the Indian Seas. Philip required for the Catholics of the united states the free exercise of their religion; but it was opposed by the states-general, and the archduke, seeing the impossibility of carrying that point, sent his confessor Briznella to Spain. This dominican was furnished with the written opinions of several theologians, that the king might conscientiously pass over the article of religion; and he was the more successful with Philip, as his minister, the Duke of Lerma, was resolved to bring about peace at any price. The conferences at the Hague were thus little impeded, though they advanced slowly till the month of August, when it was announced that the king of Spain had abandoned the question concerning religion; but it was with the certainty that his moderation would be recompensed by ample concessions in regard to the India trade, on which he was inexorable. This article became the rock upon which the whole negotiation eventually split. The court of Spain on the one hand, and the states-general on the other, inflexibly maintained their opposing claims. The other ambassadors employed every possible expedient to shake the determination of the Dutch; but the influence of the East India Company, of the islands of Zealand, and of the city of Amsterdam, prevailed over all. Reports of the avowal, on the part of the king of Spain, that he would never renounce his title to the sovereignty of the united provinces, unless they abandoned the Indian navigation, and granted the free exercise of religion, threw the whole diplomatic corps into confusion; and, on the 25th of August, the states-general announced to the Marquis of Spinola, and the other ambassadors, that the congress was dissolved, and all hopes of peace abandoned.

The ambassadors of England and of France did not, however, altogether despair of succeeding in bringing about tranquillity; and Barnevelt with his great influence joined them in all their efforts. The king of Spain and the archduke wished for a temporary repose, but, being

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strongly disliked by Maurice and his powerful party, they were compelled apparently to give way. A new congress having been agreed upon, was assembled at Antwerp; and the states-general removed from the Hague to Bergen-op-Zoom, to be within reach, and ready to co-operate in the negotiation. It did not appear so easy to make a peace as to effect a temporary truce; and, working in that direction, the two representatives of England and France, with the aid of Barnevelt, in opposition to Maurice, who resigned in disgust all his employments, but afterwards resumed them, succeeded in concluding a truce, which was at length signed by all parties on the 9th of April 1609. By this treaty hostilities were to cease for twelve years. The terms were vague and inconclusive in many parts; but as it was desirable to all parties, it became durable. The united states were declared free and independent. Each party was to retain the places they respectively held at the commencement of the armistice. In terms very obscure, the right to navigate the Indian Seas was granted to the Dutch. The article which respected religion was so expressed as to be differently interpreted; but it practically gave toleration to the Catholics in Holland, with some restrictions. The other articles settled points relative to boundaries, custom-houses, and some other internal matters. The treaty was guaranteed by the kings of France and England.

This treaty was received in both the divisions of the Netherlands with rapturous acclamation, and the most sincere demonstrations of joy. The northern division, during all the tempestuous visitations it had endured from hostilities, had risen to opulence, power, and weight, in the rank of European nations. Belgium was now permanently fixed under the sovereignty of the house of Austria, but still left in possession of some of those ancient privileges which had been transmitted to the people from the earlier times, when they composed part of the duchy of Burgundy. No sooner was the truce concluded, than Belgium, like the independent states, began to labour assiduously to repair the dreadful ravages caused by the long and bloody war. The success in Belgium was considerable, for the Archduke Albert, and his wife Isabella, joined to much probity of character considerable talents for government, and exercised the greatest possible degree of humanity and benevolence. The whole of their dominions began quickly to recover from the ravages of war. Agriculture and the minor branches of trade resumed some degree of activity; but the manufactures of Flanders, as far as they were of great value and objects of foreign commerce, were destroyed, as well as the capital necessary for their re-establishment. Some encouragement, however, was given to manufactures of the common kind for internal consumption, and the demand for them was increased in proportion as the soil, naturally fertile, became better cultivated, and the proprietors more enriched. As the port of Antwerp, the chief outlet for foreign trade, had been deprived of its shipping by the emigrations to Holland, and its only access to the sea was through the Dutch territory, there were few inducements, and fewer means of opening foreign trade at that place.

The tranquil course of prosperity in Belgium was only once interrupted during the whole twelve years of the peace. It arose from a disputed succession to the sovereignty of the adjoining German duchy of Cleves-Juliers. Two parties claimed the inheritance. The Dutch sided with one, and the Belgians with the other, and both marched armies and seized upon towns; but they never came in contact with each other, and no blood was shed, the prudence of the archduke and the forbearance of the states-general having averted the evil, and removed the alarm created in Belgium, with very little injury to its growing industry.

The Archduke Albert, who had long been a martyr to the gout, died of that disease on the 21st of July 1621, universally lamented in the ten provinces. Though his education in Spain gave him an air of reserve and of pride, and his sole use of the language of that country was not relished by the Belgians, yet he had displayed both courage and judgment during the war, and was uniformly just, diligent, liberal, and humane. The term of the truce with the states of Holland terminated three months before this event; but it was renewed from time to time for a few months, and was at length tacitly considered by all parties as having become a final settlement.

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The infanta of Spain, wife of the archduke, succeeded him as sole governor of the Netherlands; but, according to the matrimonial compact, and the clauses of the cession of Philip II., the sovereignty returned to his successor on the throne, Philip IV., her nephew. The ten provinces thus became once more a part of the Spanish monarchy. The infanta or archduchess continued in the government as vice-regent till her death, which occurred in 1633. During her government, the religious war in Germany between the Catholics and the Protestants, generally denominated the Thirty Years' War, raged with fury. Holland was agitated with theological disputes between the Calvinists and Arminians, whilst the Belgians were in repose on those subjects, having embraced with firmness the Catholic system, which was insured by the restoration of the monasteries and churches, and by the animosity created in their minds by the long war against the Protestants of Holland.

But the death of the infanta gave rise to a conspiracy against the Spanish government in the Netherlands. It is said to have arisen from the arrangement of offices, by which the commander of the army, the Duke of Berg, was mortified. The project of the conspirators was to form these provinces into an independent republic, in alliance with France and the states of Holland. The plot was, however, discovered, and some of the leaders were seized, whilst others fled. As the whole transaction was involved in obscurity, so when ascertained it was soon consigned to oblivion.

The king of Spain appointed his brother Ferdinand, a cardinal, and archbishop of Toledo, to administer the government of the Netherlands in 1634, and he arrived at Brussels with a force of more than 16,000. At that time a rivalry between the courts of France and Spain led to a treaty, offensive and defensive, between the former and the Dutch, in consequence of which hostilities were begun in 1635. As far as relates to Belgium, however, they were but of short duration. A French army advanced to the then German province of Luxembourg, occupied by the Spaniards, and in a bloody battle near Avein the latter were completely defeated. They then formed a junction with the Dutch under the Prince of Orange, entered Belgium, and captured the cities of Tirlemont and St Trond, and exercised some severities. This roused the Belgians throughout all the ten provinces. The prince-cardinal joined them with all the troops he could collect. The invaders were harassed and repulsed, and, being exhausted by forced marches and by sickness, were compelled to retreat into Holland, and, having embarked at Rotterdam, were conveyed by sea to France.

The vice-regency of the prince-cardinal was terminated by his death in the year 1641. During his government he showed considerable talent and much activity. He frequently made incursions into the frontier provinces of France, ravaged Picardy, and even alarmed Paris; and at the same time carried on a defensive war on the side towards the Hollanders. By these hostilities, the progress of industry amongst the Belgians received a severe check, whilst the demands for supplies vastly diminished the sources of that prosperity to which the interval of peace had given birth. Spain herself was also much weakened by her warlike unsuccessful operations at sea, and more especially by the revolution of Portugal, in consequence of which that kingdom gained its independence, and placed Don Juan IV. on the throne. From the want of resources on the part of Spain and her Belgian provinces, the war which affected the latter was carried on with but little vigour under the vice-regency of Mello, a Spanish general who had gained much fame by his defeat of the French army under De Guiche at Hannecourt, but lost it at the famous battle of Rocroy, where the French, who conquered, were commanded by the great Condé, and nearly annihilated the Spanish and the Walloon infantry.

In the midst of these extensive military struggles, which extended throughout the continent of Europe, and whilst England was contending for its king or its parliament, a treaty of peace was in course of negotiation by a congress of plenipotentiaries assembled at Munster and Osnaburg. Several years had already been occupied at these two places in projects and protocols. At that period all Europe wished for peace, except perhaps Cardinal Mazarin, the prime minister of France under the regency of the queen-mother Anne of Austria, and Oxenstiern, the prime minister of Sweden in the minority of Queen Christina. The emperor of Germany, the king of Spain, and the Dutch republic, were the first to endeavour to bring about a general peace; and the inferior states in a short time concurred with them. The first step was taken in 1641, when some preliminaries were agreed to and signed at Hamburg; but several years passed before other places for assembling the general congresses could be fixed upon besides Hamburg and Cologne, which had been first intended. Some proposed Worms and Spires as the two most proper cities, from being near to each other; but at length the Swedes contended for Munster and Osnaburg in Westphalia, which was then unanimously approved. The Catholic ambassadors met at the first of these cities, and the Protestant at the other. When the two parties had occasion to confer together, deputies from each met at Lengerich, a small town nearly equidistant from both.

As the negotiation had been commenced by the mediation of the pope and the republic of Venice, they both sent ambassadors to the congress. These envoys took up their residence at Munster; but Contarini, the envoy for Venice, a man highly reputed for his patience and his prudence, often repaired to Osnaburg, and by his wisdom succeeded in allaying the greatest discords.

The ambassadors who composed those illustrious assemblies were the representatives of the emperor of Germany, and of the kings of Spain, France, and Sweden, each of the ecclesiastical or secular electors of the empire; the Archduke of Innspruck, the house of Brunswick, that of Mecklenburg, of Holstein, and of Baden; the Duke of Wirtemburg, Amelia Elizabeth of Hanau-Muntzenburg, the Dowager Landgravine of Hesse-Cassel, the Landgrave of Hesse-Darmstadt, those of the imperial cities, of the circle of Burgundy, and of the cities of the Hanseatic league. From Italy there appeared an envoy from the reigning Duchess of Savoy, from the Grand Duke of Tuscany, and from the Marquises of Mantua and Montserrat. To these may be added the plenipotentiaries from the seven united and independent provinces of the Netherlands, who are noticed separately, because they treated only and distinctly for a separate peace with Spain.

The king of Portugal, Juan IV., who had just ascended the throne, but had not yet been acknowledged by Philip of Spain, sent to Westphalia his ambassador in company with the ambassador of France; but the minister of Spain declared, as soon as he arrived, that if he were admitted to the congress, he had orders immediately to retire. The emperor had demanded the admission of the plenipotentiaries of the Duke of Lorraine, and the French opposed it; and thus both the envoys of these powers were excluded. The Duke of Lorraine afterwards settled his differences with France, and was admitted at the final settlement of the treaty. The singularity of this meeting, and the important event with which it concluded, may excuse the notice of the component parts of the two bodies.

Various delays, from discussions, some of a trifling nature, some of importance, prevented even the commencement of the negotiations till 1643 or 1644; but from that time they proceeded regularly, and as rapidly as the nature of the various matters to be discussed would admit. The separate negotiation between the king of Spain and the states-general was of the most simple kind, its perplexities having been in a great degree unravelled by what had passed previous to the truce of 1609. It was, therefore, the first completed, and was signed by the plenipotentiaries of the two powers, at Munster, on the 30th of January 1648, and the ratifications were exchanged on the 15th of May following. As this treaty proceeded on the principle of the *uti possidetis*, it was favourable to the states-general, as they were in possession of more extensive territories than at the signing of the truce of 1609.

Though not immediately connected with the history of Belgium, we may here state, that the general treaty of Westphalia, by which peace was established in the whole of Europe, was definitively signed on the 24th of October 1648, to the satisfaction of all the powers except France, which complained of the Dutch having neglected to afford the stipulated support, and of the pope, who made a formal protest against the confiscation of the ecclesiastical property, and against the freedom granted to the Protestant princes to appropriate the revenues of the church to other than Catholic ecclesiastical purposes.

The peace of Westphalia, important as it was to the whole of the contending powers, proved peculiarly so to the ease and improvement of Belgium, which being now merely an appendage to Spain, had the least apparent connection with the negotiations. During the former truce the archduke and archduchess had laboured to remedy the abuses in the administration of the law which had grown up in the period of the troubles. They had sworn to maintain that compact long endeared to the Belgians by the name of the *Joyeuse Entrée*. It was formerly made to secure the states of Brabant and Limburg, including Antwerp, and to confer privileges upon other of the states; and an oath was taken at the inauguration of the duke, that if he should ever be tempted to infringe any of their privileges, none of the subjects should be bound to yield him obedience. The privileges of those states were so much valued, that it was customary for females to repair to them previous to their confinement, that their children being born within them, might have the benefit of these privileges. They granted several new charters to provinces and towns, and the privileges of the people were placed upon a footing adapted to their wants. After the peace of Westphalia, the sufferings from the recurrence of the war under the prince-cardinal were soon ended, and the joy on account of the peace and at the amount of liberty secured to them had a very beneficial effect. Anarchy gave place to regular government, persons and property were secure, the cry to arms was not heard calling the husbandman from the peaceful labours of the field, and the fertile soil was tilled with renewed industry and increased skill.

The re-establishment of the religious houses in their estates proved highly beneficial. They were mild landlords, and the peasantry that worked under them were instructed in the best means of culture. In the nunneries also industry was introduced and flourished; and the females in them were so improved, and acquired such a delicacy of touch in their fingers, that they could spin flax to a degree of fineness unequalled in any other part of the world. This gave them a great value; the nuns' thread, a kind of second-rate fineness, was sought after everywhere; and by constant practice the art of making very fine thread was carried so far, that some of that from Mechlin was sold in England as high as thirty-five pounds sterling for a pound weight, or acquired a value of more than ten times its weight in silver. Besides the fine thread which was sent to foreign countries, much of it was made into lace at home, both by nuns and by the females in private families in the towns as well as in the villages. The fame of Brussels lace was rivalled by that of Mechlin, and at a humble distance imitated in Valenciennes, then a fort of Flanders, and other towns. The soil was, and still is, admirably adapted for the growth of the finest flax; and the thread spun from it was woven into those delicate cloths which received the name of cambrics from the city where the merchants collected and bleached them, and where the trade still exists, though Cambray has since become one of the cities of France. The fine lawns of which the bishops of all Europe had their roquelaures and sleeves made, were also a product of Belgium; and, in spite of the laws which prohibited their importation in many countries, the diffusion of them could not be anywhere prevented.

It must be obvious that these branches of industry could not have flourished during the dreadful hostilities which had wasted the country; but the rudiments of the arts were not destroyed, so that they began to spread immediately after the truce of 1609, and with greater celerity after the conclusion of the peace of Westphalia, in 1648. To show the progress which had been made in agriculture, it does not seem unnecessary to notice, that Cromwell, when he obtained the supreme rule in England, sent to Flanders for husbandmen to cultivate his pattern farm at Theobolds, within ten years after the peace of Munster; and having introduced the practice of sowing clover and other grasses in the corn after the Flemish mode, became a great benefactor to the husbandry of his country.

With the revival of industry, both in agriculture and in manufactures, the fine arts also made their appearance. Painting was cherished, and the Flemings established that school which furnished works of their peculiar style, that rival the best productions of Italian art. The decoration of their religious edifices was the chief object of the artists; but in the representations of country scenery, of rural groups, of peasants, of cattle, and of domestic life, their skill has never been exceeded. Neither architecture, statuary, nor music, seem to have made much progress; and learning appears to have been almost kept out of sight, or to have passed the boundary, and taken up its residence amongst the Dutch, who in that age produced the most eminent scholars in antiquities and classics, as well as the most able cultivators of natural history and of medical science. Their theology was in a great measure confined to the dogmas of the infallible church, and their moral science to the discussions of the schoolmen. Belgium, now fixed as a Spanish province, enjoyed a long course of tranquillity. Whilst England and the Dutch, during the existence of the commonwealth and under Charles II. were carrying on hostilities, and fighting tremendous battles at sea, the provinces of the Netherlands were not in the least affected by the contest. In one instance, indeed, in the year 1672, when the united forces of France and of England were assailing the united states, the king of Spain gave orders to his governor of the Belgian provinces, Monterey, to collect an army of 10,000, and march to the relief of the Dutch. But before this force reached the scene of the war, the king of France was compelled, by the movements of a body of troops of Leopold, emperor of Germany, and by some demonstrations of the Elector of Brandenburg, added to some checks he had received from the Prince of Orange, to abandon with great rapidity the conquests he had made; and England, withdrawing from his alliance, concluded a treaty of peace with the Dutch.

Spain, however, in alliance with the Dutch and the emperor, continued the war with France. That power had an army in Brabant, with which William, prince of Orange, who had recently married the Princess Mary of England, and ultimately ascended the throne along with her, attacked the French under Condé, and in the battle of Senef first displayed his military talents. This battle was fierce and bloody, but indecisive, and was chiefly remarkable as the last action of Condé and the first of William.

In the following year the Dutch and Belgians made an attempt to take Maestricht, which, though conducted by William, proved unsuccessful. On the other frontier the French were fortunate, and took from Belgium the cities of Valenciennes, St Omer, and Cambray. William hastened to the relief of those places, and having encountered the French near Cassel, met with a most serious defeat. This led to negotiations for peace, and a treaty was concluded between the French and Dutch, at Nimwegen, in 1678, to which Spain also reluctantly acceded in the latter end of the same year.

The increase of the prosperity of Belgium was little if at all checked by these hostilities. It had been but locally, and for a short period, the seat of war. Besides, that war was carried on with much more humanity than had been displayed in the long civil war; and as the allied troops of Holland and of Germany paid for what they consumed, it is not unlikely that the high prices paid to the Belgians for the produce of their soil proved more beneficial to them than the light additional taxes with which they were charged was detrimental.

Belgium again enjoyed an interval of tranquillity, which was well employed in domestic improvement. It experienced more alarm than evil by an irruption of the French, which the Spanish army was too weak to oppose; but William of Orange agreed, in the name of the Dutch, to a truce with France for twenty years, to which the emperor of Germany and the king of Spain gladly acceded.

The accession of William to the throne of England gave rise to a confederacy of several powers against the ambition of Louis XIV.; and, at the congress of Utrecht, in the year 1690, that prince, at the same time uniting in his person the executive power in England and Holland, was named as the chief of the confederation. The war which followed was generally indecisive, as far as relates to Belgium; Mons and Namur were captured by the French, and the fortress of Huy was taken by William. Marshal Villeroy with his army advanced to Brussels, and during three days kept up a furious bombardment, by which the townhouse, fourteen churches, and 4000 dwellings, were reduced to ashes, but with no farther effect. The other events of this war, extensively as they were spread, have only a remote connection with Belgium. It was terminated in 1697, by the peace of Ryswick, where a treaty was framed very little differing from that concluded at Nimwegen nineteen years before. By the treaty Spain gained the restoration of Luxembourg, Charleroy, Mons, Courtray, and all the towns and fortresses taken by the French in the province of Luxembourg, Namur, Brabant, Flanders, and Hainault, except eighty-two towns and villages claimed by them.

The death of the king of Spain, in 1700, gave rise to a general war, which extended to almost every part of the world. He was a weak prince, without an heir to his dominions, and thought himself empowered to appoint a successor. The leading powers of Europe, and France amongst the rest, had agreed amongst themselves so to settle the succession as to balance the power, in conformity to the treaties then existing. The dying king, displeased with this distribution of his dominions, by his will bequeathed them to the Duke of Anjou, the grandson of Louis XIV. king of France, whose ambition had by his previous conduct roused the jealousy of almost all the other states. Louis, who during the peace had kept up his armies to their full war establishment, was prepared to maintain, by force of arms, the disposition of the Spanish monarch. This gave rise to the Grand Alliance, usually considered as the master-stroke of policy of King William. About the same time King James died in France and William in England; upon which Louis acknowledged the son of the former as king of England and Scotland. As William had died without issue, Anne ascended the throne. The declaration of Louis operated to unite the parties in England, and to enable the new queen to extract from her subjects extraordinary supplies for carrying on the war.

The events of this war belong to the history of Europe, and not to that of the Netherlands peculiarly, though the latter country was one of the prominent scenes of its transactions. The parties to this alliance were at first only the emperor of Germany, the sovereign of England, and the states-general of the united provinces; but other princes, both in Italy and in Germany, were subsequently included in it, either as allies or as auxiliaries. The Netherlands was a part of the countries contended for, and to a limited extent, and during limited periods, the theatre of bloody battles and sieges; but as the contending parties wished to occupy and not destroy the provinces, they suffered but little, and the contending armies expended so much money in the country, that the capital left behind was thought to be more beneficial than the injury sustained amounted to. The battering down the walls of some of the towns, the blowing up of forts, and even the casual trampling down of the growing crops, inflicted but transient inconvenience; whilst the large sums expended by the numerous troops of English and Dutch, officered by some of the wealthiest and profuse men in Europe, and paying for the productions of the soil rates far beyond the cost to the cultivators, remained in the country, and formed a capital the influence of which was felt long after the operations of war had ceased.

After various successes in some quarters, followed with reverses in other parts, France became exhausted, and was ready to make peace upon any terms; and the allies, too, were weakened and ready to enter into treaty. But the emperor and Holland wished to reduce Louis still more, when an intrigue in the English female cabinet led to a feeling in the government in favour of the pretensions of France, in opposition to the views of the allies. England resolved on peace, and entered into secret negotiations with France. Holland could hope for nothing from that power when thus left alone. The Emperor Leopold died about this time, and was succeeded by his brother Charles, who had been during the war a competitor with the Duke of Anjou for the throne of Spain. That kingdom thus became an object of less personal consequence to him than before. In these circumstances, the negotiations were commenced in January 1712, and terminated definitively by the peace of April 1713, usually denominated, from the place where it was signed, the peace of Utrecht. By this treaty, Spain, with her transmarine dominions, were secured to the Duke of Anjou, Gibraltar and Minorca to England, whilst the ten provinces of Belgium were assigned to the emperor of Germany, and now assumed the name which it long bore of the Austrian Netherlands.

These provinces were finally delivered up to the emperor in 1716. From causes which the preceding narrative must render very natural, there was considerable discontent amongst the people; and it was only by extreme severity, and almost overwhelming precautions, that a general revolt was prevented. After the first ebullitions of disgust had expended their force, as peace was restored, and prosperity followed, no difficulty seems to have been found in governing the country; and neither revolts nor punishments were spoken of during the fifteen years which passed before the accession of Maria Theresa to the imperial throne. Whatever may have been the early repugnance of the Belgian people to the Austrian dominion, they became gradually reconciled to it; and the benevolent reign of their new duchess converted the Netherland population into faithful and devoted subjects to the house of Austria. Her government was just, mild, and firm; her religious opinions and acts corresponded to their own, and she made no infringements on the *Joyeuse Entrée.* The continuance of tranquillity afforded time for industry to develop its power; and agriculture, the chief industry of the country, was constantly improving, and enriching proprietors, cultivators, consumers, and, in short, every one of the classes which composed the nation. The foreign trade, however, which had in ancient times crowded to the cities of Antwerp, Ghent, and Bruges, was not renewed, as the closing of the Scheldt had been one of the conditions of the several treaties with the Hollanders; and Ostend and Nieuport, the other seaports, were of very little use to Belgium.

The tranquillity of Belgium was interrupted by the war which broke out in 1743. The French, under Marshal Saxe, after he had gained the battle of Fontenoy in May 1744, invaded Belgium, took Brussels and several other towns, and thus placed the whole of the Austrian Netherlands in the power of Louis XV. But the treaty of Aix-la-Chapelle in 1748 terminated hostilities, and Maria Theresa was again established in her Belgian possessions, as she had enjoyed them before the war. Though reduced to a state of widowhood by the death of her husband Francis I. who had been raised by her to the imperial dignity, she ruled singly her vast possessions, with so much mildness, united to firmness, that her name even to this day is cherished in Belgium, as amongst the dearest recollections of the people. Her good sense and good feeling preserved her from overstepping the bounds of the ancient laws. She had no temptation to abuse her power, nor had her subjects any cause for want of fidelity in their allegiance. Reforms were necessary in many of the local, provincial, and commercial regulations; but in effecting them she violated no principles, wounded no opinion, shocked no prejudice, so that they were affected with but slight murmurs, and no resistance. The rude burghers of Flanders abandoned their hereditary right to an independence of the more exaggerated kind. Faction itself yielded homage to the ascendency of justice, and social civilization made a rapid progress throughout the whole country. During the Seven Years' War which terminated in 1763, the Belgian dominions of Austria bore their share of the pecuniary burdens and levies of men in the early part of the transactions; but it suffered none of those inflictions which visit a country that is itself the seat of war. After the peace of Paris, the Austrian Belgian states continued to flourish. The government was indeed an absolute monarchy; but the municipal laws still retained a great portion of their popular character, and the political privileges of the people were considerable. This mixture of sovereign power with popular rights, or rather the prerogative of an aristocracy of nobles, clergy, and lawyers, worked well and gave general satisfaction during the whole reign of Maria Theresa. In November 1780 this princess was succeeded by her son Joseph II., whose own mind was somewhat tinctured with that infectious desire of organic changes which the contest between England and her North American colonies had spread throughout Europe.

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Joseph was inaugurated with the ancient formalities, and both he and the states swore mutually, he to preserve the ancient privileges, and they to yield obedience as long as he maintained them. This compact, already noticed under the name of the *Joyeuse Entrée*, included the varying rights of the several states, those of the ecclesiastical bodies, and of the courts of law, and the privileged influence of the nobility. As Joseph examined more minutely into the interior affairs of his dominions, he saw with concern the extensive despotism exercised by the clergy, and in no part so much as in his Belgic provinces. He saw that religious power had overstepped its boundaries, and infringed upon the power of sovereigns; and he honestly felt it his duty to bring it within more beneficial limits. Had he done this by degrees, he might have gradually restored each branch to its due equilibrium; but he was anxious for a speedy reform, and not sufficiently cautious to avoid conflict with prevailing prejudices. He began by breaking the dependence in which the clerical body was united to the pope, and, by his decrees in 1781, soon after his accession, commanded the clergy to grant dispensations for marriage without any reference to the holy see. In the following year decrees were issued, commanding the celebration of marriages between Catholics and Protestants, in defiance of the canonical laws and customs then in force. Of the convents and other religious houses, which were very numerous, some were abolished, and in others the rules of the institutions were altered, if not reformed, by a simple proclamation. At length the episcopal seminaries which were under the direction and control of the prelates were abolished; and two universities were established, one at Louvain, the other at Luxembourg, which, though better adapted for the diffusion of knowledge than the old colleges, were looked upon by the priests, and also by the laity, who were under the influence of the priests, as a dangerous and even heretical innovation, and the more noxious, because they were under the sole jurisdiction of the emperor himself.

The dispositions of Joseph towards his favourite projects of reform were not restricted to the ecclesiastical bodies, but in a short time assailed the old-established and deeply-cherished administration of law, leaving to it only the ancient principles of the Roman jurisprudence. The electoral colleges of the provincial states were abolished, as well as the courts and councils by which justice was dispensed, and the whole of the signioral and ecclesiastical jurisdictions. By these decrees the lawyers, next to the clergy the most influential body, were either injured or highly offended. Some were apprehensive of losing their professional practice, and others were removed to new situations; for new courts had been erected upon a simple and uniform plan in each of the provinces, with a supreme court at Brussels controlling all the provincial courts. On this account it was deemed necessary to divide the whole territory into nine circles, by which the local powers of the magistracy were disturbed, and in many instances destroyed, without an efficient substitute being established in their stead. The privileges of the several municipal and other corporations were next violated by the appointment of their officers in virtue of the sovereign authority alone. As discontents arose from these proceedings, the states of Flanders and Hainault at length declined to vote the usual subsidies; upon which a decree was issued, stating, that in consequence of this refusal, the emperor held himself absolved from every obligation towards the states, and on that account declaring the abolition of the representation of those states. Without entering into the merits or demerits of the projects of Joseph, it is clear that the chief design of them was to benefit the people, by disseminating amongst them more tolerant feelings in religion, and a better administration of justice, by virtue of the increased power of the executive government, and not by any extension, or even intervention, of popular feeling and co-operation. At the time when these new ordonnances were promulgated, the democratic spirit had arisen in France; and though a similar tendency was not discoverable in Belgium, yet the growing discontent, caused by the introduction of measures of genuine liberality, produced an insensible bias towards republicanism, which had its effect on subsequent events.

It was not till 1787 that the consequences of the rapid measures of the emperor had raised such a spirit of dissatisfaction as to lead to the apprehension of active opposition. But as the whole body was in a state of excitement, a spark was sufficient to cause an explosion. The syndics or chiefs of the corporation of Brussels, supported by those of Antwerp and Bruges, presented memorials to the governor, Prince Albert of Saxe-Teschen, which in strong terms pointed out the danger of insurrection if the obnoxious decrees were persisted in and acted upon. The governor was alarmed, and suspended the execution of the decrees till the pleasure of the emperor could be known, and held out hopes of prevailing upon him to remedy some other complaints. These assurances diffused joy throughout the states, and the day upon which they were given, the 30th of May 1787, was ordered to be hereafter consecrated as an anniversary of rejoicing. All this joy was, however, premature. The resolution of the emperor had to be waited for; and he was with his army carrying on the war with the Turks. On his return, two months afterwards, so far from ratifying the concessions made to his Belgian subjects, he despatched his mandates in an angry tone, declaring that he had never intended to subvert their constitution, but sought only to correct abuses and introduce salutary reforms. He required as a proof of obedience, that the states of each province should send deputies to Vienna, to lay their complaints at the foot of the throne. He professed to retain the sentiments of a father, and knew how to pardon the errors and temerity of his subjects, but threatened them with severe chastisement if they refused the mark of respect that he demanded. He also informed them, that he had called to the capital the governor of the provinces, and the commander of the army, that they might act as mediators between him and his subjects.

This intelligence filled the provinces with consternation; but it was nevertheless resolved that deputations should proceed to Vienna. Whilst on their road, accounts reached them on all sides of the prodigious force which was on its march to the Netherlands, and of the consent of the several princes between that country and Austria having been given to the passage of troops through their dominions. But these rumours, instead of terrifying the Netherlanders, roused them to resistance. The most prominent leader of the party was Vandernoot, a lawyer of some eminence, who had been the most energetic orator in the states.

When others had been arrested, he made his escape, and found refuge in England. He now repaired to Breda, and there established a kind of committee, who conferred on him the title of agent plenipotentiary of the people of Brabant. He attempted to draw the Prussian, English, and Dutch governments into some negotiations, with a view to favour the cause of the dissatisfied Belgians; but though unsuccessful in these attempts, he succeeded in inflaming the passions of the people to a high degree of religious frenzy, a work in which he was zealously assisted by the powerful exhortations of the ecclesiastical body. The Netherlanders were in all ages a military people, and, when once roused to activity, capable of displaying great energy. Arms were seized by the populace, and a commander offered himself in the person of Van der Mersch, a soldier of fortune, who had risen from the ranks to the command of a regiment during the Seven Years' War. A formal act by an armed body under this commander declared that the Emperor Joseph had forfeited the sovereignty of Brabant; and this was followed by the advance of the forces he had collected in the direction of that province. His conduct was cautious and considerate, and he diligently directed his efforts to introduce order into bodies of men inspired with a degree of fanatical confidence which it was difficult to restrain within the necessary bounds of discipline. The Austrian troops were few in number, and Van der Mersch approached them cautiously. Having by some feints and stratagems induced them to follow him into the narrow streets of the town of Turnhout, situated between Antwerp and Breda, a bloody contest took place, in which the imperialists were finally defeated, with a loss of lives far exceeding that which the army of the insurgents had suffered. He immediately penetrated into the province of West Flanders, where he was received with open arms by the inhabitants, and speedily became master of Ghent, which was taken by assault, and of Bruges, Ypres, and Ostend, which voluntarily surrendered. The imperial government now thought it prudent to withdraw from Brussels; and upon this the states of Brabant and Flanders assembled, on the plan of the ancient constitution in that city. Soon afterwards Vandernoot and his associates arrived from Breda, and having made a triumphal entry with great solemnity and parade, were received with the most joyous acclamations by the enraptured inhabitants. The imperial forces being dispersed, and no fresh succours arriving, the states, in 1790, formed a treaty of union, which comprehended the seven provinces. Hitherto all had been done by the excitement of religious bigotry; but there soon began to appear symptoms of a fanaticism of the very opposite character. Van der Mersch, the successful general, was accused of holding French principles; and Vonck, an advocate of Brussels, was inculpated in the same charge. In the violent squabbles of party it is difficult to ascertain the truth; how far these men had imbibed Jacobinical opinions, or whether they had imbibed them at all, it is difficult and needless to ascertain. It became, however, the signal of disunion, of which the Catholics availed themselves in order to excite general abhorrence of Van der Mersch, as a monster of impiety and treason. Vandernoot, aided by an ecclesiastic of more talent than himself, named Van Eupen, took the lead in the general assembly of the nation. Religious fury was carried to the greatest excess; and the excited populace, urged on by the clergy, proceeded to the most violent outrages against the opposite party. Vonck and his party fled to save their lives, and their houses were broken into and pillaged by the populace. Scenes of the most revolting nature were exhibited throughout the country. These were encouraged and even participated in by the priests, who, with the sword in one hand and the crucifix in the other, breathed out the most horrid imprecations against those whom they called infidels or heretics.

During these proceedings the army became totally disorganized and inefficient. An open rupture took place between the commander of the forces and those who had the direction of public affairs. The troops abandoned their general, and adhered to the civil rulers, chiefly on account of their attachment to the Catholic religion. He left the army, accompanied with the curses of the populace, by whom Vandernoot and Van Eupen were almost deified. In Brussels, the people bent the knee when they gazed on the picture of the one, and uncovered their heads when they pronounced the name of the other.

Whilst the Netherlands were unassailed by open hostilities on the part of their imperial sovereign, and the bigoted party were indulging their narrow-minded measures of policy, the Emperor Joseph, who, with respectable talents and the best intentions, had failed in every thing he undertook, was removed from this life. He died on the 20th of January 1791, accusing his Belgic subjects of having caused his death, and was succeeded in his extensive dominions by his brother Leopold.

Leopold manifested much sagacity and moderation in the measures which he adopted for the recovery of the revolted provinces; but their internal disunion proved his best ally. The states-general occupied themselves almost exclusively in attempts to re-establish the monkish institutions which Joseph had abolished; and having dismissed their able general on account of heresy, and thereby disorganized the army, they had the temerity to reject with scorn the overtures which the new emperor addressed to them.

The imperial forces had been collected on the frontier, and the command given to General Bender. These troops with their appointments were sufficient to overcome all opposition that could be offered by a country the government of which was compounded of ignorance, bigotry, and rashness. As the imperialists advanced into the provinces, town after town opened its gates; Vandernoot and his associates saved themselves by a rapid flight, and sunk into obscurity. A short campaign gave the emperor quiet possession of the whole of the provinces; and, on the 10th of November 1791, he concluded a convention with England, Holland, and Russia, by which an amnesty was granted for all past offences, and assurances given to the people that their ancient constitution and privileges would be respected. In conformity to this treaty a succession of edicts were issued, revoking all the offensive ordonnances of his predecessor, re-organizing the provincial councils, and re-establishing the form of government on the same popular footing on which it had existed during the reign of Maria Theresa. These arrangements were only completed a little before the death of Leopold, an event that happened suddenly on the 1st of March 1792. His son Francis II. succeeded to the throne, and under his reign the final separation of the Belgian provinces from the imperial family took place.

The new emperor, soon after his accession, found himself involved in a war with revolutionary France. His forces, conjointly with those of Prussia, invaded that country, and, after advancing to Champagne, were repulsed with tremendous loss. France then became the assailant of those powers and their allies, and one of her first great efforts was directed against the Belgian provinces of the house of Austria. The battle which decided their fate was fought at Jemmappes, near Mons, on the 6th of November, and terminated in a decisive victory in favour of the French, commanded by General Dumouriez. The result of this action was to place the whole of Belgium at the mercy of the conquerors. The Austrians were driven out of the country. Dumouriez made his triumphal entry into Brussels on the 13th, and, immediately after the occupation of that city, the whole of Flanders, Brabant, and Hainault, with the other Belgic provinces, were subjected to France. Soon afterwards, several pretended deputies from the Belgian people hastened to Paris, and implored the convention to grant them a share of that liberty and equality which were to confer such inestimable blessings on France. Various decrees were in consequence issued; and, after a variety of procedure, the incorporation of the Austrian Netherlands with the French republic was in due form decreed, at the commencement of the year 1793, whilst the scaffold was preparing for Louis XVI.

But, even in the first moments of enthusiastic excitement, few of the Belgians wished for a junction with France; the spirit of nationality was still uppermost, except with those who were mercenary or fanatical. A number of individuals had formed themselves into what they called patriotic associations, in the several towns of

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Belgium, and, being drilled into obedience by commissaries despatched from the French convention, sent their emissaries to France to misrepresent the national feeling. There were however in Belgium many men of cool judgment, respectable character, and large property, who saw both injury and danger from the proposed annexation; and they sent counter-deputations to explain the difficulties attending the proposal. Each of the deputies who asked for the conjunction was honoured with the *accolade* by the president of the convention, whilst each petition on the other side was received with indifference, and its reasoning unheeded. The peaceable remonstrances were put down by the clamour of the adherents of the French Jacobins. Dumouriez himself even wrote to the convention, that the wishes expressed in Belgium for the junction with France "were forced from the people by strokes of the sabre." In spite of the efforts to oppose them, however, the decrees for a union were issued, and preparations made for their practical adoption. But they were for a time frustrated by the events of the war. The strong city of Maestricht still held out against the French. It was besieged without success, owing to the want of military skill on the part of Miranda, a Spanish American, who had been transformed into a general. This, with the circumstances arising from Dumouriez quarrelling with the convention, his unavailing attempt to turn the army against them, and his ultimate flight, had greatly demoralized and disorganized the French army; and it was in this state when the campaign opened in March 1794. The Austrians had collected on the frontier towards Germany a large force under the Prince of Saxe-Cobourg, which entered Belgium, and gained the battle of Neerwinden, with many other less considerable contests, owing to which the French were compelled to abandon all their conquests with a rapidity quite equal to that with which they had accomplished them.

The Belgian provinces were thus once more restored to the house of Austria, and the emperor nominated his brother, the Archduke Charles, as his viceroy. His occupation of that post, however, was but of short duration. The frontier provinces of Belgium became the seat of bloody contests, in which were opposed to France armies composed of Austrians, Germans, English, and Dutch. Without here entering into details, we may remark, that the question respecting the occupation of Belgium was determined by the battle of Fleurus, fought on the 25th of May 1794. After that important victory, the French became masters of Belgium; and the representatives of the city of Brussels once more repaired to the national convention of France to solicit the incorporation of the two countries. This, however, was not finally pronounced till the 1st of October 1795, by which time the rapacity of the French commissioners, and the violent measures enforced, had given a tolerable sample of what might be expected from an arbitrary government concealing its despotic tendencies under the cloak of liberty. The discussion in the French convention on the subject of the annexation of Belgium had occupied two days; and there were not wanting a few members who resolutely opposed the union, and spoke boldly against the injustice of the measure, founding on the repugnance of the Belgians, as well as the dissimilarity in point of religion, manners, and morals between the two countries. Reasoning, however, was of little avail when opposed to the ambitious spirit which actuated the majority of the convention, who already looked to the period when, by the extension of their limits, the Rhine should form the eastern boundary of the republic. A new system for a division of the Austrian Netherlands and of the bishopric of Liège into nine departments was adopted, and they were declared integral parts of the French republic. This new state of affairs was at length consolidated by the preliminaries of peace signed at Leoben, in Styria, between Napoleon and the Archduke Charles of Austria, and confirmed by the treaty of Campo Formio, signed October 1797.

From the occupation of Belgium, its history as a nation becomes a blank for nearly twenty years. It formed a part of France, and shared the triumphs and defeats of that country under the republic, the consulate, and the empire. The ancient institutions, in the defence of which the people had revolted against their former governments, were completely swept away; their religion was also stripped of its power, its decorations, and its ministers reduced to almost apostolical poverty. Their monastic and charitable institutions were either abolished, or, by the confiscation of their valuable property, reduced to the most depressed state. The laws, and the courts of justice, which were endeared to them by usage, were made to give place to a new system, administered by incompetent magistrates. They became subject to a system of taxation, which, though equal in its distribution, was heavier than Austria had ever required either in peace or in war. But the worst of the requisitions was that for personal service in the armies of the conqueror, and which was so extended in its demands by the conscription law, as to be deeply felt in every domestic circle. Such were the evils which, if the Belgians durst not openly complain of them, they never ceased to lament; but it must be observed, that the property of individuals was protected by the government; that agriculture could be pursued, and any improvements the cultivators chose to adopt introduced; and that, both in France and in Holland, they had good markets for their produce. From political circumstances, the manufacturers were protected against the rivalry of English woollen, and especially cotton goods, which, as far as the fabrication of them extended, became a beneficial employment of capital. The mines of iron and of coal, chiefly in the province of Hainault, were beneficially worked; and the hardware of Liège and its vicinity afforded occupation to a hardy race, and such wages as enabled them to subsist in a state of moderate comfort.

At the commencement of Napoleon's government, he had arranged and established an excellent system of local administration in the whole of his vast dominions; but it was a system, like that of all arbitrary monarchs, which required the vigilant superintendence of the hand that had framed it. In the latter part of his reign the whole of his mind was absorbed in the single point of gaining that universal dominion which had become his grand object. Owing to the absence of his vigilant attention, the system had not been so strictly adhered to as it should have been; and throughout the whole of France, but especially in Belgium, the local administration had become confused in its action, and of little benefit to the community. The roads, bridges, canals, and public edifices, except as they were connected with military purposes, had been neglected, and were gone to decay for want of early reparation. The greatest evil that arose from this negligent administration was felt in what relates to the education of the people. In Belgium, as well as in the majority of the departments of France, amongst the inferior classes of society, the youth grew to maturity in a degree of ignorance approaching to brutality. There existed everywhere something that resembled public schools; but they were in a most deplorable state, dirty, dark, and without order; whilst the teaching was limited to tracing a few words or letters, and to reading or reciting a few passages without understanding the sense of them. Useful books were not provided, and the children were frequently observed, from the want of better means, handing from one to the other an old almanac, a torn book of prayers, or the detached pages of some old newspaper. The condition of the instructors was commonly wretched, and the discipline practised was either harsh or indolent, or both.

In Holland, a most valuable system of local administration had prevailed, which from ancient times had been found highly beneficial. When that country was added to France, the system had not yet given way to the general plan of the empire, and the roads, canals, and dikes, as well as the schools, had been left to the same direction and superintendence as formerly. Under the reign of Louis Bonaparte, they had been cherished and somewhat improved; and the consolidation of Holland with France had hitherto produced none of the evils which affected Belgium. To this circumstance may in some measure be attributed that difference of character between the two people, which will be found displayed in the subsequent events that come under our notice in the progress of this history.

Except in one important respect, the country now called Belgium, when forming only a few departments of France, may be viewed as rather in a flourishing state. The demand for personal service, however, pressed heavily on it, as well as on all the other portions of that great empire, inasmuch as it robbed the land of the labourers who were required for its cultivation, and left a large portion of the work to be performed by the females, or by the males who had not reached maturity, or had passed the age when the human frame is capable of severe labour.

The evil of the conscription was, however, counterbalanced by the freedom from actual warfare. The scenes of contest had been removed far from its boundaries, and, during the whole period of the union with France, its fields had been untrodden by armies. Two attempts had been made by England to invade Belgium. The first was the landing of a few troops intended to destroy the means of water communication. They disembarked at Ostend, and, after damaging some of the sluices, were under the necessity of yielding to a superior force. A grand attempt was made in the year 1809 to take Antwerp, and to create a diversion in favour of the allied powers, by operating from Belgium on the communications of Bonaparte's army, then advancing towards the east of Europe. This, however, though the largest naval and military force that had ever been despatched from English ports, proved a total failure; and it never reached Belgium, its advance having been retarded, and the design at length frustrated, by the siege of Flushing, and a most dreadful mortality amongst the troops on the island of Walcheren.

The internal tranquillity of Belgium, whilst vast armies were collected in other parts of Europe, had considerable influence on the great pecuniary interests of that country. Its chief productions are those of the soil and of the first necessity. The consumption of the vast armies had raised the prices in every part of Europe, and none reaped greater benefit from the advance than those who cultivated the fertile fields of Belgium.

The reverses experienced by the French armies during the invasion of Russia were followed by others of a similar kind in Germany, till the issue of the great battle under the walls of Leipzig, in October 1813, excited a general hope throughout Europe of being delivered from the military tyranny that had long oppressed it. This hope gave animation to the minds of the men of Germany, more especially at first, and was from them rapidly communicated to other countries. Its effect was powerful in Holland; but, if felt, it was scarcely perceptible in Belgium. The difference in feeling between the two divisions of the Netherlands may in part be accounted for from the longer duration of the union of Belgium with France, which had now reached its twentieth year; whereas Holland had been incorporated with that empire but little more than three years when the battle at Leipzig decided the fate of Europe. Belgium, under the character of a portion of France, had enjoyed a degree of prosperity in its agricultural industry; whilst Holland, mainly depending on foreign and colonial commerce, had been brought, not to the verge, but into the very gulf, of ruin. The feeling of nationality had been weakened during twenty years in Belgium, whilst it had been strengthened in Holland by three years of suffering. The mode of action in the two countries at the crisis produced by the victory of Leipzig merits notice here, because upon the contrast between them depended the character of that series of transactions which subsequently occurred.

The intelligence of the defeat of the French had no sooner reached Holland, than a spirit began to show itself which alarmed General Molitor, who commanded the forces of Napoleon in that country. His head-quarters were in Amsterdam; and fearing an insurrection in that populous city, he resolved not to be surprised in the narrow streets, but, contrary to the opinion of Le Brun, duke of Plaisance, and of Count Celles the prefect, withdrew with his troops to the more defensible city of Utrecht. The whole of the French troops in Holland did not exceed 10,000 men, and a part of these were in garrison in the fortified places. The intolerant tyranny of the French government had made the whole population ripe and eager for revolt. This disposition was taken advantage of by a few able, influential, and patriotic men, the most prominent of whom were Count Gysbert Charles von Hogendorp, eminent as a diplomatist and statesman, and Count Van der Duyn de Maasdam, a man of enterprising genius and judgment. On the 21st of November 1813, they made the first movement at the Hague, unsupported by any armed force, excepting a few of the old city guard, and a number of gentlemen with fowling-pieces, and solemnly proclaimed that the people of Holland had returned to their ancient state of independence and freedom. Amsterdam, at all former periods the most powerful city, and the focal point of the ancient union, was the first to renounce its preponderating superiority in the government, and, immediately after the movement of the Hague, proclaimed the Prince of Orange as the sovereign of the country. The decision of Amsterdam was communicated from city to city, and received an universal concurrence, plainly showing the spontaneous wish of the whole Dutch nation.

A provisional directory was immediately formed, consisting of six persons, who sent Messrs Fagel and Perponcher as envoys to England, to recall the Prince of Orange to his native country, from which he had been long banished by the foreign domination that had ruled it. The allied armies on the frontiers were made acquainted with the events which had transpired; and when some of their forces arrived, they found the insurrection had been so successful that nothing was needed but a short space of time to consolidate the power gained by the arrival of the prince. During the events of the few days, the force under Molitor at Utrecht was kept inactive by the movements of General Bulow and his division of the Prussian army, which had arrived at Munster, and was advancing towards Arnhem.

The Prince of Orange landed on the 30th of November, at Schevelling, and his arrival in his native country completed the great work of its enfranchisement, and the establishment of its political and civil freedom. The invitation had been spontaneous, and the government had been offered to him with no restrictions or conditions; but he gave instant proof that he had no desire for arbitrary power, by issuing a proclamation, in which are the following words: "Je me rends à vos vœux; mais je l'accepte uniquement à condition qu'elle soit suivie d'une constitution qui garrantisse vos libertés, et les mette en sûreté contre toute atteinte."

On the 6th of December the prince assumed the sole executive authority, and brought to that task all the active industry, penetration, and regularity by which his

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whole reign has been distinguished. The fortresses were mostly held by the soldiers of Napoleon. Many bodies of the allied armies were on the frontiers, but none felt more acutely than William that no country can be independent in the presence of foreign armies, whether consisting of friends or foes. He wished that the same hands which had conquered the national freedom should defend and maintain the precious blessing; and that thus the allied powers might be enabled to unite their forces, and march on towards France, where the decisive battle of liberty was to be fought. The first object, therefore, was the formation of an organized army; but this was attended with immense difficulties. The country was completely destitute of arms, ammunition, and every thing necessary for the equipment of an army, so that it was impossible to clothe the new levies; and the severity of that remarkable season prevented the removal of stores from one part to another, and the arrival of the various necessary articles which were provided and despatched from England. Notwithstanding these difficulties, an army of 25,000 was enrolled, armed, and equipped in the space of little more than three months, out of a population of 1,800,000 souls, in a country which had been previously drained of active men by the conscription, and some parts of which were still held by the enemy. In the month of March the prince was enabled to announce to the public that a force to that extent was ready, and would soon be united on the frontier under the command of his eldest son, who had distinguished himself whilst serving in Spain under the Duke of Wellington.

The formation of a constitution proceeded simultaneously with the creation of an army. The first sketch of the constitution had been framed by Count Hogendorp. It was submitted to the consideration of fifteen persons of the most approved integrity and most enlightened judgment; and after their revision it was transmitted to the prince, who accepted it as the fundamental law of the state, as being in harmony with the manners and the habits of the nation, and conformable to the wants and the spirit of the age.

The scheme, thus far approved, was then printed and distributed over the whole country, previous to the assembling of a meeting of Notables, who were to be selected for that purpose from all the provinces and towns, including persons of all religious persuasions, whether Jews or Christians. Twelve hundred names were selected, of the most proper persons, being householders of various descriptions, but not including those in the service of others, those who had, within the last six months, been relieved by the public charitable institutions, or those who were insolvent, in prisons, or under the surveillance of the police. The lists were ordered to be exposed during eight days, in each small district in which a justice of peace was established, that each householder might affix his approval or disapproval of the individuals named in them. One half the number, as determined by these votings, were to be excluded, and the remaining 600 were appointed to meet on the 24th of March. After a few hours spent in deliberation, the acceptance of the fundamental law was decided by a majority of 458 votes against twenty-five. There were 117 absent, many of them kept away by unavoidable circumstances, some by a feeling that they were not sufficiently authorized to give a decision on so important a subject, some from judging that the power of making peace and war was held by the prince alone, and a few from religious scruples. The more rigid Calvinists thought the Protestant religion would suffer by admitting persons of all persuasions to public offices, and some Catholics complained that there was not a sufficient provision made for the maintenance of their clergy and their institutions. If the whole of the absent members had voted, as their opinions were well known, it was calculated that the measure submitted to them would have been accepted by five sixths of the number.

Mr Chad, secretary of legation from the court of St James's, who was then officially in Holland, says, "Persons accustomed to the spectacle of the impetuosity and ardour of political discussions in England, would perhaps have been surprised at the calm moderation with which this transaction was accomplished in Holland." But he adds, that from all the information he could in any way acquire, he never could learn that the government of the prince made the least attempt to control, or even to influence, the public opinion.

In consequence of thus organizing a form of government, the prince assumed the title of king, and his eldest son that of Prince of Orange. The state which had thus secured its own independence was immediately acknowledged as such by all the governments of Europe; not by the formality of any treaty, which would have weakened rather than strengthened the right, but as an assumed fact, evidenced by the mission of ministers to the court of king William from the sovereigns of the great powers of the civilised world.

We turn now to the conduct pursued by the Belgians in this crisis, not with the view of inculpating the people of that country by the contrast, but in order to place before the reader a simple narrative of the occurrences. No effort was made, nor the slightest indication displayed, which could give encouragement to the cause of the allied powers against the common enemies of Europe. It is probable that the Belgians saw, with great though silent satisfaction, the progress of the allied armies. But the Belgian provinces were not, like those of Holland, situated at the extremity of Napoleon's empire, and thus out of the reach of that immediate chastisement which a premature revolt would surely have brought down on them. It would have been difficult to create a central point round which to rally the scattered elements of insurrection; nor had the Belgians a family or chief upon whom to fix the general hopes of the country, or fitted to secure the confidence of foreign powers. But, worse than all, they had no legitimate and acknowledged nationality that could inspire them. Their past recollection could only present to their minds the prospect of a subservient junction with some other country, such as had always been their fate; and as they had no expectation of being left to their own choice in that junction, there was little to inspire them with the ardour of patriotism.

No hostilities took place in Belgium, except an attack by bombardment on Antwerp by a united force of English and Prussians, which was productive of no consequences, as the army of the latter was ordered to advance into the territory of France itself.

The French troops abandoned Belgium as the allies advanced, and in January 1814 the Duke of Saxe-Weimar, one of the allied generals, entered Brussels without any opposition. But his troops had merely a military occupation of the country; and the emperor of Austria, then advancing towards Paris, despatched from Dijon Baron Vincent, who had been commissioned *pro tempore* to act as governor of Belgium.

From the events in Holland and Belgium our attention must now be turned to Paris, where the allies, after driving away Napoleon and seating Louis XVIII. on the throne, had convened the ministers of the several powers, to restore tranquillity and order in those parts of Europe which had been disorganized by the victories of the French empire.

This august assembly, in the midst of the congratulations which the extraordinary scenes that had thus collected them produced, did not forget the perils they had

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escaped, nor the danger which might still arise behind the glory of their triumphs. Bonaparte was indeed dethroned, and a Bourbon seated on his throne; but the spirit of foreign conquest and universal dominion was not extinct in France, with its millions of men still animated by the desire of domination, and smarting under the severe mortifications which their vanity had recently suffered. The throne that had been restored was still in a tottering state, all the institutions which formerly supported it having been swept away; and, besides, the remains of the defeated armies would soon be joined by thousands of men who, having been made prisoners, would return filled with angry passions, and fully prepared to aid in any combinations which might have for their object the plunder of foreign countries, the subjugation of foreign potentates, and the superiority of the military over the civil authority throughout France itself, as well as over all Europe.

Aware of the dangers lurking behind their success, the allies directed their attention to such measures of security as seemed most advisable, in case a re-action in France should again throw the power of that kingdom into the hands, first, of the populace, and then, as a necessary step, into that of some military leader.

Belgium had, by the right of conquest, fallen into the power of the allied sovereigns. From its position it had been the battle-field of Europe in former periods; and the possession of that country by France would be of vast importance as an advanced post, from which she might easily proceed to other conquests. The house of Austria, having always found the Belgian provinces a source of trouble and annoyance, was ready to abandon its claims; trusting thereby to secure some advantages nearer the centre of its power. The Netherlands, if united under one power, might be sufficiently strengthened to become a strong barrier against France, and the means of securing the continuance of that general peace which was then so much desired, and indeed wanted. Belgium, and the other territories near it, the bishopric of Liège, and the duchy of Luxembourg, were considered merely as European objects, which were so to be disposed of as would best suit the purposes of the combined powers, particularly that of securing the tranquillity of the great community of nations. It was not, then, from any peculiar favour to Holland, or from any personal regard to King William, though his minister formed one of the assembly, that, in less than two months after the seizure of Paris, it was adopted as a principle by the representatives of all Europe, and promulgated to the world, "that Holland, placed under the sovereignty of the house of Orange, should receive an increase of territory." This declaration was made on the 30th of May, and at the time received with general approbation, although at a subsequent period it was one of the principal grievances set forth by the Belgians in their declaration of independence. The principle thus announced received its final sanction by a treaty dated the 21st of July, in virtue of which Baron Vincent was to deliver over to King William the provisional power he exercised in Belgium, upon the following conditions, viz. 1. That the two countries should form one state, governed by the constitution already established in Holland, to be modified by common consent: 2. That there should be no alteration in that part which assured to all religious sects an equal admissibility to public offices: 3. That the states should assemble in alternate years in a city of Holland and in one of Belgium: 4. That all the inhabitants of both parts should be alike in all commercial matters, without any restriction being imposed on one for the benefit of the other: 5. That the provinces and cities of Belgium should be admitted to the full enjoyment of commerce with the colonies: 6. That all expenses should be in common, and the debts of the two parts should be assumed by the treasury of the kingdom: 7. That the expense of maintaining and strengthening the fortresses should be defrayed from the common treasury: and, 8. That the cost of supporting the dikes should be furnished by the districts more immediately interested in them; but in case of any great disaster, succours were to be supplied by the general government, in the same manner as had formerly been practised in Holland. The king of England, by a separate treaty, on the 13th of August, agreed to give up to the newly-created king of the Netherlands all the conquests made from the Dutch during the war, with the exception of the Cape of Good Hope, and the settlements of Demerara, Essequibo, and Berbice, on the continent of South America.

By the treaty of the 21st of July, the government of the Netherlands accepted, on the conditions therein stated, that sovereignty over the Belgian provinces which the allied powers had offered, not from any peculiar feeling of regard to the interests of King William or of Holland, but as a European benefit, "de pourvoir à l'établissement d'un état d'équilibre en Europe, et en vertu de leur droit de conquête sur la Belgique." The duchy of Luxembourg was not a portion of Belgium, but a part of Germany; and that division was given up to the king of the Low Countries, by the German confederation, of which he was a member, not in his regal capacity, but in consequence of his transferring to Prussia the sovereignties, hereditary in his family, of Nassau-Dittenburg, Siegen, Hademar, and Dietz.

After the union of the two countries had been settled by treaty, and the whole delivered up to the government of William, it was thought necessary to submit, not the union itself, but the fundamental law or constitution, to the acceptance of the people. That constitution had already been accepted by an almost unanimous vote in the northern division, but it was deemed necessary to submit it also to the southern division. An assembly of Notables was accordingly convened in Belgium, on the same plan as had before been pursued in Holland. The number of the members of this assembly was 1600, but not more than 1325 attended. Upon the vote being taken, there appeared to be 529 in favour of accepting the constitution, and 796 against it; and thus, as far as that assembly was concerned, the acceptance of the proposed constitution was negatived. The government, however, took a different view of the subject, founded upon the assumption, that the union being adopted must be considered as a fact not to be questioned; and that this was a question for the united kingdom, which must be determined by a majority of the whole. For this purpose, the statistical view given of the kingdom was thus represented.

The inhabitants of the northern division, or what was before Holland, were	2,071,181
Those of the south part, or Belgium	3,411,082
In all	5,482,263
The votes in favour of the acceptance were stated to be the whole of the northern part	2,071,181
Two fifths of the southern part, who voted by their 529 delegates	1,364,432
	3,435,613
The majority of the Belgian representatives, who voted for three fifths of that part, amounted to	2,046,650
Thus giving in favour of the constitution, or fundamental law, a majority of	1,388,963

We have given an account of this proceeding, because it was subsequently made one of the grievances complained of. The assembly had been chosen fairly, and consequently under clerical influence, which was decidedly op-

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posed to the toleration of any other party than the Catholic religion. This was proved by a kind of protest, issued under the title of "Jugement Doctrinal des Evêques du Royaume des Pays-Bas, sur le serment préscrit par la Nouvelle Constitution." In an authoritative style it condemns the liberty given to appoint persons of any religious creed to offices of power and trust; and it reprobates the enactment that the Catholic church was to be submissive to the law of the state, that the other religious sects were to be protected in their worship, that the government was to have the power to regulate all the seminaries of the kingdom, and that the liberty of the press was recognised. It concluded with these words: "Mais dès qu'une loi humaine est intrinsèquement mauvaise, et opposée à la loi divine et aux lois de l'église, on ne peut, sous aucun prétexte, s'engager d'y obéir." This declaration was signed by all the prelates, viz. the Archbishop of Malines, and the Bishops of Ghent and of Tournay, and the vicar-general of the chapter of Liège. It is natural to suppose that such a declaration must have had great influence with people so ignorant and superstitious as the lower classes of the Belgian population are universally allowed to be, and averse as they had ever been to a connection with the Dutch, who were represented to them as a combination of heretics. The nobles are also said to have been more attached to the ancient Austrian government; but the middle classes were supposed to have more sympathy with the French than with the German nation, and to be peculiarly jealous of the Dutch.

Whatever may have been the common sentiment, of which it is always difficult to judge, not the least appearance of discontent was displayed at the promulgation of the constitution, or the public entry made by the king and his family into Brussels. His first efforts there, as they had been in Holland, were directed to the means of defence; and all due exertions were employed for the purpose of raising an effective and numerous army. In this much progress had been made when the intelligence arrived that Bonaparte had escaped from Elba, advanced in a sort of triumphal procession through France, and again assumed the imperial title, and all the power connected with it.

The alarm and terror created by this event had the effect of, in a great measure, disarming the power of the ecclesiastical fulminations, and uniting all classes with the new government in preparing for the contest which was evidently about to take place on the frontiers of the kingdom. The time spent by Bonaparte in Paris in organizing his recovered army, and in conciliating the several parties in his capital, was most actively employed by the king in strengthening his means of defence; and a great advance had been made in his military affairs, when it became evident that the first inroad of the French would be on the side of Belgium.

An army composed of Dutchmen and Belgians, but chiefly officered by the former, was collected and led towards the frontiers by the Prince of Orange. When the French entered Belgium, these troops formed the advance of the allied army. It encountered the French at Quatre-Bras, and, aided by the British, resisted during the whole day (the 16th of June) the attacks of the left division of the French army, commanded by Marshal Ney. The loss of lives on both sides was great; but that action had a powerful influence on the issue of the battle of the 18th, as it gave time to bring up the whole of the allied forces, and place them on the field of Waterloo, where the decisive conflict took place which decided the fate of the French empire, and gave a long peace to Europe. During the whole of that day the troops of the Netherlands sustained the character for courage which past centuries had established. There were probably a few instances of overpowering terror, and some solitary examples of disaffection, arising from past associations with the French; but the great principle of public duty pervaded the Netherlands army, as was proved by the loss which they sustained in the battle. The victory was cemented by the blood of the Prince of Orange, who stood at the head of his troops throughout the whole of that arduous day, encouraging them by his cool and determined conduct. On one occasion he made a desperate charge on the enemy, and advanced so far that he was actually in the midst of the French, and in the greatest danger, when a Belgian battalion rushed forward, repulsed the enemy, and, after a desperate struggle, disengaged the prince. From the impulse of his gratitude, and his admiration of the bravery displayed, he tore from his breast one of the decorations gained by his conduct in some preceding action, and flung it amongst the battalion, calling out, "Take it, my lads; you have all earned it." This decoration was eagerly grappled for, and tied to the regimental standard amidst loud shouts of "Long live the Prince," and vows to defend the trophy, in the utterance of which many a brave man received the stroke of death. A short time afterwards, towards the close of the battle, the prince was hit by a musket-ball on the left shoulder. He was carried from the field, and conveyed to Brussels the same evening in a cart, accompanied by two of his aides-de-camp, one of whom, like himself, was badly wounded; displaying to those near him as much indifference to pain as he had previously shown contempt of danger.

The battle of Waterloo appeared at the moment to have consolidated the establishment of the kingdom of the Netherlands. It seemed to have attached the military part of the Belgians to the prince who had been wounded at their head, and who had led them to that victory which they so mainly ascribed to their own exertions, as almost to forget that the troops of any other nation had contributed to it. Advantage was taken of this feeling to commence the working of the new constitution, which had been accepted, as before noticed, by a majority of the whole kingdom, though rejected by a majority of the Belgian portion. The solemn inauguration was held a few weeks after the battle, and much interest was excited by the appearance of the Prince of Orange, on the occasion, still wearing his wounded arm in a scarf, and with the palid countenance of an invalid.

The constitution was then declared to have been accepted by the people, and no allusion was made to the irregularity of the decision, as the objections once urged had arisen from repugnance to religious toleration; those who had urged them being sensible that any allusions to the subject would have been unavailing amidst the prevailing military enthusiasm. None was made, but such were certainly nourished, to be brought forward at some moment more favourable for making the desired impression. No murmurs were heard, and Belgium became, or appeared to have become, reconciled to the arrangement which had been made by the allied powers.

The speedy concentration of the two divisions was a spectacle viewed with astonishment, whilst a thousand channels were opened for the egress of national industry, capital, and enterprise. Every obstacle seemed to have vanished, asperities were softened down or concealed, faction seemed dead or paralysed, and a quiet enjoyment of the present formed the only public manifestation. The people of Belgium appropriated to themselves the glorious victory of which their country had been the theatre. The king, by his love of peace, and by his activity in whatever could improve the institutions and the condition of the country, at first gained a high opinion amongst those Belgians who were able to endure the religious toleration he established; and amongst others his personal virtues, his

Netherlands. domestic habits, and his unwearied industry, as favourable a view was taken of his character as could be formed of one who had the misfortune to be a heretic. This last party was soothed, if not reconciled, by the exertions which he made to recover and restore to their churches those pictures and other objects of value which had been pillaged by the French and carried to Paris.

The naval transaction of the following year, when a squadron of Netherlands ships joined the fleet under Lord Exmouth in the attack on Algiers, was another circumstance favourable to the consolidation of the new kingdom; for although the battle was gallantly fought by Dutchmen, yet the Belgians took care, in the exercise of their vanity, not to allude to the Hollanders; and as they had forgotten the English at Waterloo, so they now gladly assumed to themselves the glory of the united victory. The prosperity of Belgium made it the chosen residence of many respectable foreigners, as well as the place of refuge of others of the most opposite descriptions. The king busied himself less in projects to secure popularity, than in efforts to benefit the country; and it may here be proper to notice the institutions which were either established or ameliorated, and the beneficial consequences they produced.

Under the rule of France, Belgium, like the other parts of the Continent, had suffered severely from the operation of the conscription laws, which had deprived the country of those active labourers who were necessary to cultivate the fields. Although peace could not restore the great numbers who had perished, yet it stopped the farther progress of the evil in the Netherlands, by the establishment of a voluntary enrolment for a small regular army, and of a militia, whose service was required only for one month in the year. The mines felt the benefit of this regulation. The minerals of Belgium consist of coal, iron, and calamine. As soon as the union had been formed, and labourers became less scarce, a great impetus was communicated to this branch of industry; and companies were formed, who were most liberally repaid by the profit of their investments in this branch of industry, which was augmented from year to year as long as Belgium and Holland constituted one kingdom. By the excitement communicated to mining, the provinces of Liège and Hainault, and a part of Namur, were greatly enriched; and a company formed to explore the mines of Luxembourg were amply rewarded in their labours and their profits, till interrupted by internal commotions. The various branches of manufacturing industry received a similar impulse, though at first they were checked by the peace. The continental system of Bonaparte had given a factitious encouragement to some articles of manufacture, which ceased with the return of peace; and, till the formation of the kingdom of the Netherlands, many branches were depressed by the rivalry of foreign goods in the markets to which they had access. But as soon as the junction was completed, a stimulus was given to the manufacturers, by opening to their goods the markets of the East and West Indies, and those of all countries with which the Hollanders had traded. The iron manufactures of Liège advanced rapidly in prosperity; the woollen manufactures of Verviers felt most powerfully a similar impulsion; and many large establishments were formed at Ghent and other places, where cotton goods were fabricated which rivalled those of England, and so far surpassed those of France, that much of the goods were sold by the contraband trade in that kingdom. The opening of the Scheldt was the necessary effect of the formation of the united kingdom. Merchants from various countries formed establishments with large capitals at Antwerp; its docks became crowded with ships from all countries; its warehouses were loaded with colonial and other produce; and it advanced rapidly to a rivalry with Amsterdam, Rotterdam, and Hamburg, in the transit trade to the interior of Germany. The king directed his best efforts to the state of the roads, the greater part of which had suffered dilapidation, whilst the cross roads, so important in a country chiefly agricultural, were in many places scarcely passable. The management of the former was under the general government, whilst that of the latter was superintended by the local authorities; but in the first few years of the union the whole were repaired and placed in the most excellent state. The interests of internal navigation were sedulously watched over by the king. The old canals were repaired, the shallow parts of the rivers were deepened, and new and important water communications were formed. The chief of these, the Canal Guillaume, which extends from Maestricht to Bois-le-Duc, was an expensive but highly beneficial work; whilst that of Antoing in Hainault, that of Charleroy in the province of Namur, and that of Ternuse in Flanders, have been found in a very high degree beneficial. Though no longer of any importance to Belgium, it may not be quite out of place to remark, that the spirit of improvement which spread throughout the whole kingdom was to be seen in Holland in the Grand Canal of North Holland, which opens to Amsterdam a way for ships of the largest size to the ocean by way of the Helder, without incurring the risks arising from the shoals of the Zuyder Zee.

Some other plans of this kind had been decided on, when the disturbances broke out which ended in this disjunction of Belgium from Holland. One of these was to make the river Sambre navigable; the other was to form a canal from the Meuse to the Moselle, by means of which the prosperity of the duchy of Luxembourg would have been greatly advanced.

The state of education, from the schools for primary instruction up to the universities, was in a wretched state when the king ascended the throne. In Holland it had ever been an object of the greatest consideration; and it had received from Louis Bonaparte, during his short reign, a degree of perfection which fitted it for reception in Belgium. Normal schools for the instruction of teachers were early founded; and as soon as any were found qualified, they were fixed with moderate stipends in the rural districts where they could be most beneficially placed. To such an extent was this plan of organizing primary schools carried during the first ten years of the reign of William, that their number in 1826 was 3329, in which the pupils were taught reading, writing, arithmetic, and the system of weights and measures. The numbers of pupils in the several schools of Belgium were 156,075 boys and 116,761 girls; in Luxembourg the numbers were 19,925 boys and 14,819 girls.

The schools for higher instruction were improved, and the number of students in them yearly increased. In ten years they had risen from 3400 to 7048. These were in general the institutions in which the youth were prepared for the universities. The king founded a new university at Liège, in addition to the two previously existing at Louvain and at Ghent. Great care was taken to procure the most able men in every branch of science; and as the country was rather deficient in such as possessed eminent qualifications, it was found necessary to repair to foreign lands for help. Several were invited from Germany, and others from France and Italy. No one establishment for education in Europe could boast of more distinguished names than those of the individuals who filled some of the professors' chairs, both in Liège and Ghent.

Whilst in the united kingdom the surface appeared smooth, and the vessel of the state seemed to be making a rapid progress, an under-current was perceived to be making its way in a direction not favourable to permanent tranquillity. At first William gained the highest applause from his Belgian subjects. The whole kingdom exhibited a show of bustling activity, if not of prosperity. Amongst the re-

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fugees from other countries, the king and people were spoken of as models of public and domestic happiness; the diplomatists joined in the flattery, and prided themselves on the skill with which they had accomplished the tranquillity of Europe, by founding the kingdom of the Netherlands; and all united in the assertion that the king was much too good for his Belgian subjects.

For several years this favourable or flattering state of affairs continued, though thoughtful people soon discerned, from events unnoticed by superficial observers, the prognostics of future disunion. At the earliest meeting of the representative house, the different languages spoken by the members caused some difficulties; a Belgian in the discussions speaking in French, and a Hollander replying in Dutch. Too many of the questions brought forward might be of a local nature; and in these, as the whole of the Hollanders voted on one side, and the whole of the Belgians on the other, the decision was often dependent on the accidental absence of an individual on the one side or the other. The equality of numbers between the Dutch and Belgians made it difficult to come to a settlement on such subjects as affected the interests of the two countries in a different or opposite way. This was first exhibited on the subject of a free trade in corn. The Dutch provinces had never produced sufficient corn for their consumption, but a free trade in it had always furnished them with a sufficient supply. The Belgian provinces grew more corn than they consumed. As in the other parts of Europe during the last years of the war, the prices of corn had risen to an enormous rate, and the Belgian proprietors of land had increased their rents in due proportion. With the return of tranquillity the prices of grain and the rents of land were much reduced; and the Belgian members of the assembly desired to impose restrictions on the importation of grain. This was naturally opposed by the Dutch members, whose interest was engaged in favour of low prices, both as regarded the subsistence of the inhabitants, and the trade of the distilleries. The question was finally decided in favour of the freedom of the trade; but the contest gave rise to the formation of two parties, so equally balanced as to make the decision of many legislative questions dependent on accident.

As the royal authority had been established in Holland the greater part of a year before the union with Belgium, it had been organized without reference to that event. Holland had been a shorter period under French power; and during the prevalence of that influence when King Louis filled the throne, its government had been carried on upon the principle of nationality; the fittest men filled the offices in the different departments, and many of them remained unchanged when Holland became a French department. It was natural that King William should continue such men in their offices, and that in selecting officers for the new branches which were to be created, a preference should be given to natives, of whom there were numbers whose education, habits, and patriotism had well fitted them for the public service. At the union of Belgium and Holland the whole administration was in the hands of French functionaries, who speedily disappeared. Few men in Belgium had been brought up in such a way as to form them for official duties, and those who had sufficient information and capacity had been nominated to employments in the distant provinces of France. Under these circumstances, the greater number of officers was necessarily appointed from the northern division of the kingdom. Another cause of many offices in Belgium being filled by Dutchmen was, that some of those Belgians to whom offers were made declined to serve, on account of the influence of the priests, which prevented them from taking the oath to a constitution, one of the first stipulations of which was an equal freedom to all religions.

A complaint was brought forward, that in the appointment of officers in the army an undue preference had been shown in favour of the natives of Holland; and as Mr Northomb, an opponent of the house of Orange, in his work entitled *Essai Historique et Politique sur la Révolution Belge*, has placed the numbers in a statistical point of view, this matter is entitled to examination. According to his statement, in 1830 the officers of the army of the kingdom of the Netherlands is thus shown:

Rank.	Whole Number of Officers.	Belgians.	Belgians settled in Holland.
Generals	5	0	0
Lieutenant-generals.	21	2	1
Major-generals	50	5	2
Colonels	48	8	1
Lieutenant-colonels.	48	9	1
Majors	137	19	0
Captains	211	38	3
Lieutenants	808	115	2
Sub-lieutenants	639	82	0
	1967	278	10

This great disproportion is in some measure lessened, from the circumstance that many of the officers were Germans, some were Swiss, and some were natives of other countries. With this allowance, the exact number of which is unascertained, the contrast between the whole and the Belgians is very striking. Baron de Keverburg, a partisan of King William, gives a different account, making the whole number of Belgians in the army to be 536 instead of 278. In his work entitled *Du Royaume des Pays Bas*, he asserts of his catalogue that it is "d'après des renseignemens puisés à des sources authentiques;" but, even on this showing, the more numerous population supplied but one fourth of the officers. This is accounted for, if not justified, by the baron, on various grounds.

When Louis Bonaparte became king of Holland, he sedulously attended to the formation of his army; and when he abandoned the throne the armed force was so well trained, equipped, and officered, that, on the annexation of Holland to France in 1810, it formed a military body equal to any other of the empire in its adaptation to the purposes of war. When that army was transferred to France, the different grades of officers retained their Dutch rank, and their former course of promotion. But when the people of Holland rose against France, and raised William to the throne, the Dutch resigned their posts in the French service, and repaired to their own country, where they were gladly received, and reinstated in the rank which they had attained during their service in France. It will be seen by the list of Mr Northomb that all the generals were Dutchmen; but that rank had been acquired in the French service, where, by their military talents, they had gained high reputation, and had been honoured and trusted by the French emperor. The names of the Dutch officers thus appointed generals by William are well known. Tindal had been raised by Bonaparte to the rank of general, and commanded a regiment of his body guard. Jansens had been distinguished as governor of Batavia, and in the army of the French emperor on the Ardennes frontier. Daendels was one of those Dutchmen who had been always placed in posts of the greatest danger, and had displayed the highest skill and valour. Dumonceau, though a Belgian by birth, had by his long service in the northern provinces become a Dutchman, and was highly esteemed in the French army. Chassé, an old officer of

Holland when he was transferred to the French service, became known by the familiar title of *Général Baïonnette*, and afterwards distinguished himself by his gallant defence of the citadel of Antwerp.

When men like these returned to their liberated country, and at a moment when their services were wanted, there were no rivals to compete with them in Holland, and they were necessarily placed at the head of their profession. Those of the successive ranks who also returned, as almost the whole did, were retained in those ranks in the army, formed first in Holland, and afterwards strengthened by the addition of Belgians. The Belgian officers serving in the French army had not been kept apart, but mixed up with the Frenchmen. They had formed a part of the general conscription; few had raised themselves to the rank of officers; and of these only three had attained the grade of colonel, no one having risen higher. Being thus insulated, they had nourished little or no national feeling; some few tardily returned to their native country after the occupation of Paris; but many of them remained in the service, and fought against their country at Waterloo.

The king, in the hasty organization of an army, naturally availed himself of the materials within his reach, and adapted them to the emergency. When after the battle of Waterloo peace was established, it would have been highly unjust to the brave men who had assisted there not to have confirmed them in their ranks, or to have placed others over them merely because they were born in Belgium. But for these, and even for such as had fought against their country, and repaired to it after the victory, the provision made was the best that could be effected at the time; and they were subsequently placed in new corps, retaining their former rank and seniority.

The utmost economy was practised respecting the army; and from the number of good officers in the highest classes, and their seniority, there was no prospect of rapid promotion. Thus the gentry of Belgium had but little inducement to enter the military service, so that, without attributing to the king any great partiality, the facts here stated sufficiently account for the greater number of officers belonging to one division of the kingdom.

The other charge of partiality on the part of the king, which ultimately became one of the grievances, was, that, in the legislative body, the number of deputies was as great from the northern as from the southern division of the kingdom, although the number of inhabitants in the latter was so much greater. The foundation of this settlement of the relative numbers was based upon the principle of giving legislative power according to the rate of revenue to be extracted from each division, rather than according to the number of the population. The proportion of revenue raised in Holland was nearly equal to that raised in Belgium; indeed it was shown, at a subsequent period, to be as fifteen to sixteen. The rate of revenue per head in Holland was sixteen florins, and in Belgium ten florins. Whether the rate of revenue or the number of inhabitants be the proper scale for regulating the proportion of legislators, is not a subject to be discussed in this place.

In the distribution of the higher civil offices of the government, complaints were urged and magnified into weighty grievances by the Belgians. On this subject the statements of Baron de Keverburg, when confirmed by the official part of *L'Almanach Royal*, are as follow:

The cabinet consisted of six members. It was formed before the union of the two countries, and was composed wholly of Hollanders; but after the junction of Belgium, two of the members withdrew, and two Belgians were admitted in their stead. The first chamber of the states-general, similar to our House of Peers, but nominated by the king for life, contained fifty-six members, of whom thirty were Belgians, and twenty-six Hollanders. The *Conseil d'Etat*, or privy council, was composed of twelve Dutch and eleven Belgian members. The Prince of Orange and his brother Prince Frederick presided over the two divisions into which it was formed; one for the direction of the army, the other for that of the naval force. The *Chambre des Comptes*, or treasury, consisted of sixteen persons, taken equally from the two divisions of the kingdom. The judicial authority of the provinces and communes was in general intrusted to persons chosen in the division in which they were to execute their duties. There were a few exceptions to this rule, for two Dutchmen exercised these functions in Belgium; but two also, natives of Belgium, filled the same offices in Holland. Thus far there was an equality; but in North Brabant the judicial office was filled by a Belgian, which gave a trifling superiority to the southern division.

It may fairly be presumed, that in the appointment of officers in the several civil departments, the king had been mainly influenced by his view of the capacity of the persons selected to discharge the necessary duties; for at a subsequent period, when the most scrutinizing activity was exercised to discover grounds of complaint, no accusations were made of any other fault in the appointments than that which related to the portion of the kingdom to which the functionaries belonged. The king himself was active and regular; and being in a great degree his own prime minister, he must have been peculiarly anxious that the persons under him should be adapted to their several stations, and certainly under no government was more industry exercised or more regularity preserved.

Many of the important institutions of the country had, by the constitution, been left to the will of the king as to their local establishment. The seat of the states-general had been fixed by that law to be alternately in Belgium and in Holland, but not the place for the king's residence or the council of state; yet these also, though with some personal and political inconvenience, were made changeable, business being transacted six months of each year at Brussels and six months at the Hague. But the supreme court of justice, the court of appeal from all the inferior tribunals of the kingdom, was permanently fixed at the Hague, to the great disadvantage of the more numerous suitors in the southern part of the kingdom. This formed a material, and apparently a just cause of complaint; and nothing has been stated by the Dutch which has disproved the inconvenience, though attempts have been made to represent the practical injury arising from it as very trifling and insignificant. Several other establishments were also made permanent in Holland, such as the state archives, the diplomatic offices, the council of the nobles, the coinage of money, the military and naval boards, the academies for the instruction of naval, artillery, and engineering officers, and the principal naval and military arsenals. This arrangement was justified upon public grounds by the partisans of the king. The kingdom, they affirmed, had been established as an European object, and to form a barrier for the defence of all the powers against the ambition of France. In any display of that ambition, Belgium would, as heretofore, become the first theatre of war, and, in spite of the range of fortresses about to be erected, might be occupied by an invading army. If the means of carrying on the war fell into the enemy's power, the effect might be fatal; but by having the establishments farther from the frontiers, and where they could be guarded by natural defences, the war might be kept up effectively behind the rivers and canals of Holland, so as to render the advance of the enemy a dangerous or a ruinous step.

There are in Belgium a variety of languages spoken, and the attempt of King William to introduce one uniform tongue created much discontent, and was by a great and

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influential part of the inhabitants considered as a serious grievance. The far greater portion of both the northern and southern inhabitants are of German origin, and their vernacular language is chiefly composed of Teutonic words. It is divided into several idioms, namely, the Dutch, the Flemish, and the Brabant. These three are so nearly similar, that those who use them understand each other better than the English and Scotch peasantry do. The Dutch language has been more polished than either of the others, having been the tongue of some of the most learned men that Europe has produced. It contains books of art, science, literature, law, theology, and history of the greatest merit, and which have been the means of spreading knowledge of all kinds to a great extent. The care bestowed on education has produced a greater number of readers and writers than are to be found in any other country of the same limited population. The Flemish and Brabant dialects have been little cultivated; few books have been written in it, except those of devotion, the lives of saints of the Catholic church, almanacs, and spelling-books. The numbers who read them are very small in comparison of the whole population, but with the rural inhabitants this dialect is the general medium of intercourse.

During the French dominion great pains were taken to extend the use of their language, and with much success as far as regarded those who had enjoyed the advantage of even the commonest education. This has extended the use of that language amongst those above the lowest classes; and it is said that even in Holland there are more persons acquainted with the French tongue than in those parts of Belgium where the other dialects of Teutonic origin are used. The Walloon language, a corrupted dialect of the French, is commonly used in the provinces of Hainault, Liège, and Namur; and the German language is most prevalent in Luxembourg.

Baron de Keverburg, assuming the population of 1829, gives the statistics of languages as follows.

The divisions in which the German is used, and their population:—

In Holland	2,329,974
In Belgium, the provinces of Antwerp, Limbourg, and the two Flanders	1,971,056
The largest part of Brabant	380,177
One half of Luxembourg	151,317
	4,832,524

The divisions in which the French and Walloon are used, with their population:—

The provinces of Hainault, Liège, and Namur	1,124,595
The arrondissement of Nivelles, in the province of South Brabant	126,733
One half of Luxembourg	151,317
	1,402,645

In this view the Dutch language is used by two fifths of the population, the other languages of German origin by two fifths, and the French and Walloon by one fifth. From the most remote periods all public affairs in Belgium were transacted in one or other of the Teutonic idioms. The *Joyeuse Entrée*, the Magna Charta of the country, was originally drawn up in the Teutonic dialect, and was only translated into French at a recent period, when the princes, no longer residing in the provinces, began to give a decided preference to that language; but all the proceedings of the states of Brabant were conducted in it till the conquest of the country by France. From that moment all public deeds were written in French, and the subdued people supported with pain the loss of their native tongue; but they dared not utter a complaint. This attachment of the Belgians to their native language was shown to have been little weakened by their subjugation to France; for when the allies had freed them from that yoke, and Baron Vincent was appointed governor *ad interim* by the house of Austria, a petition was presented to him by the ancient representatives of the city of Brussels, who resumed their former titles under the name of *Syndics des neuf nations, et des cent quarante-trois doyens*, complaining of the compulsory use of the French tongue. The petitions were favourably received, and an arrêt issued on the 18th of July, authorizing the use of the Flemish language, not, indeed, in all public writings, but in all notarial writings.

When this provisional government ceased by the accession of King William to the throne of the Netherlands, he proposed to redress what was then deemed one of the grievances of the country, by a decree of the 1st October 1814, which stated as a fact, "that, in consequence of the union with France, the national languages of the provinces had been almost suppressed, to give place to the French tongue;" and then added, "that if it was necessary on one side still to tolerate the use of the latter language in some parts where the Flemish is not used, it is but just, on the other side, that the Flemish, which is the natural language of the country, should be re-established in all the parts in which it is used and understood." The king was certainly desirous of restoring the national language, and of restraining the use of the French; and for a time, whilst it was gratifying to the great body of the people, it occasioned very little complaint upon the part of those who alone spoke or understood French. Gradual enactments were made to induce practitioners to study the national languages; and three years were allowed to acquire them, at the end of which time those who did not understand them were to be removed to other stations, where they could practise their official duties in the tongue they were most familiar with. At the expiration of the prescribed time, 1st of January 1823, a decree fixed the following arrangement on the subject of languages:—1. The use of the French language shall be preserved in the Walloon provinces of Liège, Hainault, and Namur. 2. The use of the Dutch language shall continue to be maintained in Holland. 3. The use of the Flemish language, in its several idioms, shall be re-established in the Flemish provinces. 4. The German language shall be used in the German part of the grand duchy of Luxembourg. In short, it was provided that the official language in each of the provinces should be that which was used and understood by the mass of the people who inhabited them.

The profession of the law in Belgium forms a body which, next to the clergy, is the most formidable body of any. They had been trained by the study of French eloquence, and the young advocates, when called upon to plead in the language of the country, were often mortified by the ridicule of the audience. They did not wish to incur the displeasure of the Belgians by degrading their language, and therefore directed their attacks on the Dutch language, which, for that purpose, they confounded with the Flemish. In these attacks they were joined by the writers of many pamphlets, and also those of the public journals. The attacks were very violent. From those on the Dutch language they passed on to attacks on their literature, on their manners, and their morals. The Dutch writers, irritated by these attacks, replied and defended themselves; and thus arose, from mere literary disputes, a powerful and enduring animosity between the two countries.

The subject of religion was one which, above all others, served to produce discontent. A set of writers who neither had, nor pretended to have, any religious principles, encouraged the government at first in measures of toleration, according to the fundamental law, and were, or affected to be, vehement against the Jesuits, who opposed it. William was no bigot in religion, but it was his desire to raise the character of the Catholic clergy, by imparting to them a more extensive and better education than had previously been necessary before entering on their office. With this view he framed regulations which offended the clergy and the ignorant party who submitted to them, and who were at length joined by those who distinguished themselves as liberals, as soon as they saw that some advantages could be drawn from that union to forward their own republican views.

The Catholic clergy in Belgium had submitted to the regulation of their affairs which French subjugation had imposed. The vicar of the diocese of Ghent has indeed been unwilling to allow this; but Baron de Keverburg, himself a Catholic, and under the French regime governor of West Flanders, asserts most positively that the imperial institutions were observed in Belgium as elsewhere; that the catechism of the empire was taught to almost every one; and that the four articles of the clergy of France formed a part of the religious instruction in all the Belgian departments. As soon as the kingdom was established, they brought forward claims to power which they dared not even to whisper under Napoleon, and even carried those claims to an extent beyond what they had been urged for the last three or four centuries, and beyond what are acknowledged in the Catholic kingdoms of Europe.

The vicar-general of Ghent had required, as essential to the establishment of the kingdom of the Netherlands, "le rétablissement de tous les articles des anciens pactes inauguraux, constitutions, chartes, *et cetera*, en ce que concerne, non seulement le libre exercise de religion Catholique, mais aussi les droits, privilèges, exemptions, et prérogatives des évêques, prélats, des maisons-dieu, et des autres institutions religieuses quelconques." A single exception was indeed admitted to this exercise of power. The church would indulge the monarch so far as "accorder au prince et à sa cour des chapelles, bien entendu seulement dans l'enceinte des palais royaux." Thus these old powers, which the French had destroyed twenty years before, were to be restored; and then the prelates would allow, but only to the king and his family, the toleration of his own worship in secret. According to the principle of the prelates, the chief and sole duty of the temporal power was, in its relation to the Catholic church and its clergy, limited to "protéger la religion et ses ministres, à faire exécuter les lois de l'église, à faire punir les actes extérieurs nuisibles à la société religieuse."

This extraordinary claim of the church to a power independent of, and in fact governing the state, would not, on its own account, have deserved the notice here taken of it. It was at least quieted by the prudent conduct of the king, who suffered the Count Mean, one of the prelates, upon his nomination to a seat in the council of state, to swear to the tolerating constitution under a protest, that if the pope should declare the oath to be contrary to the rights of the church, it should thereby cease to be binding. The king, whilst he adhered to the constitutional principle of tolerating other sects, extended his liberality to the Catholic clergy, by increasing the stipends of the inferior orders; by making provision for those who, from age or infirmity, were incapable of performing their duty; and by contributing liberally to the erection or repairs of churches where the communal funds were inadequate to the purpose. The opposition of the clergy was for a time dormant; but it was again roused, when, at a subsequent period, the leaders of the church formed a junction with the leaders of the French party, and thus placed the lower classes, who could not read their effusions, but were under the influence of the priests who spoke to them in Flemish, in a state of hostile excitement towards the government. The hostility of the clergy was much aggravated by the attempts made to improve the education of the priests. The king had determined that no priest should be inducted who had not passed two years in the study of the *literæ humaniores* before his ordination, and appropriated a college at Louvain for that purpose, to which was given the unfortunate name of the *philosophical* college, a name with good Catholics almost equivalent to infidel or heretic. The prelates, to counteract this, established seminaries connected with the cathedrals, in which the pupils were instructed in their humanities. These contravened the design of the king, and were forcibly shut up. It was an objection to the philosophical college that the professors of history were not priests, but laymen, and some Protestants. This may not seem a solid ground of declining to attend lectures on history; but it was so with the Catholics; for, as their doctrines rest quite as much on tradition as on the Holy Scriptures, it was of vast importance that history should be taught by those alone who were orthodox in their opinions. In truth, the critical spirit of some of the German professors would make sad work with many parts of the traditions held sacred by the Catholic church. The prelates, in the discussions on this subject, indulged in language of a violent kind, and were prosecuted. A law enacted by Napoleon was made the instrument of condemning one or two of them to banishment, and excited no small degree of hatred amongst their adherents, who, if not the most enlightened, were the most numerous, portion of the inhabitants. These mortifications were increased by circumstances of inferior importance. Some of the religious festivals were curtailed, certainly with no views inimical to religion, but to benefit the morals of the people, by lessening the number of days that were devoted to idleness and drunkenness. The architecture of the national schools was similar to that of the reformed places of worship, and the youth of the country were forbidden to be educated out of the kingdom. These trifles were magnified into matters of plain evidence of a regular system to proselytise the whole of the Netherlands. Whilst these controversies respecting religion and education were carried on, the conduct of the king was applauded and encouraged by the active party of the liberals, who represented them as proper steps to secure the people from the insidious attempts made by the Jesuits to blind and cajole them. There was no evidence of any plan of the kind on the part of the Jesuits, and it was only affectation in the liberals to insinuate it. It served their turn for the time, but was soon forgotten, when it appeared advantageous for their party purposes to join with the most bigoted of the Catholics against the government of the house of Orange.

Another subject was at times brought forward, and must be added to the causes of the internal disunion between the two parts of the kingdom. The number of members of the representative body had been fixed at the time of the union, and made equal for Holland and for Belgium. The subject was then investigated with the greatest deliberation, and all parties were content. It had been suggested that Belgium brought, to form the kingdom, a more numerous population than Holland, and therefore ought to have a greater proportion of members in the assembly. But, upon the other hand, it was shown that the colonies which Holland brought to the common stock contained, in Asia, Africa, and America, as many persons as rendered them equal in number, and, in regard to common advantage, much superior to Belgium; and, besides this, it was urged, that the Dutch contributed to the common cause a powerful fleet and an army, with the stores belonging to both services. This point was, however, settled with perfect cordiality, and remained at rest during several years. But at length it was thought necessary to extend to Belgium the Dutch system of taxation on the grinding of corn. This was severely felt, and gave rise to renewed agitation as to the inequality of representation in reference to the numbers of inhabitants. It became a more prominent

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object, because the tax was imposed only by a majority of two votes, all the Hollanders voting for the measure, and all the Belgians but two against it.

During the whole of the period from 1815 to 1829 the popularity of the monarch was very variable. After the uttering of some loud complaints, as alleged grievances arose, they seemed to die away and be forgotten; and, till some new cause supervened, the king was as much respected as his best friends could wish. At no time, indeed, was his personal character assailed; and the general feeling in Belgium was, that he always meant well, but gave too ready an acquiescence to what they tauntingly called the schemes of their *Dutch cousins*.

The king, attacked by two parties, by the priests and their bigoted followers on one side, and by the republicans on the other, avowed his intention to act with indifference to all parties in the pursuit of what he deemed for the general advantage. In conformity with this disposition a *concordat* was in 1827 entered into with the pope, by which the right of nomination to the bishoprics was settled. It was provided that each should be selected by the pope out of three individuals to be nominated by the king, and that the education of the priests should be under the control of the prelates; but that in the seminaries professors should be appointed to teach the sciences, as well as what related to ecclesiastical matters. This arrangement was highly satisfactory to the cool and thinking part of the community, but was far from pleasing to the extravagant partisans. The clergy thought that too little had been granted to them, and the liberals that too much power was conferred on their order. Conciliatory as this measure was intended to be, it thus proved nugatory; and several nominations of Belgians to offices before filled by Dutchmen had no better effect.

Brussels at this time contained a most heterogeneous foreign population, consisting of the intriguing and discontented subjects of almost every country of Europe. There were of Frenchmen, regicide conventionalists, exiled Napoleonists, and proscribed constitutionalists, besides Italian carbonari, expatriated Poles, Spanish liberals, disgraced Russians, English and Irish radicals, and visionary students from the various parts of Germany. As the greater part of these had but insecure means of subsistence, and for the most part understood the French language, the press groaned with libels, not more against the Belgian than against all other governments, and thus contributed towards the production of a high state of political excitement. The press of the capital also furnished cheap editions of such works as, either from their irreligious, immoral, or democratic tendency, were prohibited in France; and thus became a nuisance to the regular governments of Europe. The great mass of the population could not be inflamed by these fire-brands; few of them could read, and fewer still could read French. They were, however, acted upon by other means. The Flemish preachers, schoolmasters, and confessors, in their several spheres, were ready to join in any movement, and were sure to be supported by the idle, the dissolute, and the indigent, with which the cities and large towns abounded. To bring the whole body of discontent to bear upon the same point, it was found advisable to form the two parties into one; and this was achieved by the liberals affecting a zeal for the Catholic faith, which they had before treated with contempt and ribaldry. The union was thus formed, meetings of the parties were held, the junction was openly announced, and threatenings were promulgated tending to give confidence to the confederacy, as well as to excite apprehension in the king and his ministers.

This system of agitation was carried to an extent which no government could behold with indifference, however confident in the rectitude of its measures. It was attempted to oppose the calumniating writers by employing others to counteract their influence; but the attempt was far from successful, as in that kind of warfare the assailants have almost always the advantage on their side. The avowed object of the liberal writers was to urge the clerical party to make such extravagant demands of extensive power as they knew, if granted, would be the ruin of the royal authority, and if refused, would increase the agitation they had already created. Although the whole of the Dutch members of the representative assembly, and several of the most respectable of the Belgian members, gave a majority in favour of the royal party, yet many of the latter adopted most inflammatory language, and, as far as the rules of debate allowed, seconded the views of the united party of the liberals and bigots.

As the union openly flung defiance at the government, it appeared necessary to bring before the courts of law the most notorious of the inflammatory writers; and two were selected as subjects for prosecution before the court of assizes of South Brabant. These individuals are thus described by the Baron de Keverburg. Of the first, Louis de Potter, he says, "Il s'était fait remarquer longtemps avant les troubles de la Belgique par dés écrits qui, aux yeux de l'église, étaient reputés fort impies, et, aux yeux des hommes doués, d'un peu de délicatesse, de très-mauvais gout. Ce que j'ai de dire sur le second est moins honorable encore. M. François Tielemans, avant l'époque pre-indiqué, n'était connu que par les bienfaits qu'il avait reçus et qu'il continuait de recevoir du roi, et plus tard il le fut par son ingratitude envers son bienfaiteur."

These men, with two others, likewise editors of journals, were sent to the tribunal in which Van Maanen filled the office of presiding judge. The prosecution terminated in a sentence of banishment from the kingdom for the period of eight years; a sentence which brought on the judge the execrations of the libellous journals, and elevated the prisoners to the rank of martyrs. The sentence was put in force by sending the culprits to the frontiers, where they were detained, as neither of the neighbouring states would admit them. The revolution of July occurred in Paris whilst they were in this state; and the party which prevailed in that city allowed them to enter France, and they were received in the capital with great applause by the propagandists.

The popular mind in Brussels was highly agitated by these trials, which did not operate to restrain the indignant language of the journals, nor the distribution of the most vehement placards, many of them in the Flemish tongue, in which the minister Van Maanen, and the editor of a royalist journal entitled the *National*, were held up to the public indignation, and threatened with vengeance. In this state of the public feeling, the news of the success of the Parisian mob in overturning the throne was received with enthusiasm. Numbers of the young propagandists from Paris reached Brussels. Assuming to themselves the character of heroes of the revolution, and with feelings of disappointment at the tranquil issue at which it had so soon arrived, these young men displayed the three-coloured cockade in the streets and public places; talked loudly in the theatres and coffee-houses; sang the Marseillaise and Parisienne hymns in chorus with impassioned groups; and dwelt with enthusiasm on the glories of the republic and the empire, and the future destinies of their "young France." Some of the more active of the Belgians repaired to Paris, and are said to have sounded the new government on the subject of the re-union of their country to France, in the event of the dissolution of the monarchy of the Netherlands. These last were, however, mere adventurers, who had little or no power over, or intercourse with, those who were destined to influence the fate of Belgium.

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The disturbances which followed at first may be easily concluded to have been the result of mere popular excitation, such as is often seen in large cities. The first symptom of outrage was presented by the audience of the theatre, on the 25th of August 1830, after the representation of a piece, the *Muette de Portici*, which abounded with passages well calculated to kindle a flame amongst materials well charged with inflammable particles. When the curtain fell, the excited audience rushed into the street, exclaiming, "To the office of the National." They ran thither, soon forced in the doors and windows, and began the work of destruction. They then rushed into the dwelling of the editor, which was speedily demolished, though the obnoxious individual, whose life was threatened, made his escape unhurt. The house of Van Maanen was that next assailed. It was plundered, and then set on fire, and the populace stopped the fire-engine from playing till every thing in it was consumed. The police-office was then attacked; the books, furniture, pictures, and plate of the chief magistrate were brought out and burnt in the street; and the hotel of the provincial governor shared the same fate; whilst some private houses and several manufactories were pillaged, and otherwise much damaged. Fury, confusion, or terror were visible in every countenance, before the civil and military powers made any attempts to stop these disorders; and those which were made showed a want either of the courage or the coolness necessary to act with decision. "From this conduct," says an eye-witness, "before ten o'clock on the morning of the 26th, the guards and posts in the centre of the city had been overcome, or had tranquilly surrendered; and the troops who had been drawn out either retreated to their barracks, or were withdrawn to the upper part of the city, where they piled their arms in front of the king's palace, and renounced all attempts at suppressing the tumult."

By the operations of these two days, the multitude had in fact gained the mastery of the city, and every one in it felt himself exposed to whatever private malice, political fury, or the love of plunder, might induce the populace to inflict. This moved a few of the more influential inhabitants to take up arms, and to enrol themselves into a burgher guard, for the protection of their lives and property. Within three days, not less than as many thousand persons, chiefly heads of families, had enrolled themselves in this corps, and, under chiefs of their own selection, paraded the streets; so that, if they did not put a stop to plunder and destruction, they at least contributed in some degree to contract the extent of the mischief. In such circumstances, the actual power within the city devolved on those who obtained the direction of these hastily organized and scarcely armed citizens. They determined on resisting the troops, which were advancing; and the general who commanded them having no precise orders from the king to act, readily agreed to suspend the march, and entered into a kind of treaty of neutrality with the burghers, till they could receive directions from the Hague, where the king and his family had that year their residence. The intelligence of these events in the capital soon spread throughout the provinces, and in all the large towns, excepting Antwerp and Ghent, similar scenes were exhibited, commencing with plunder and outrages by mobs, and settling down into an uneasy but rather more secure state by the institution of burgher guards.

The intelligence from Brussels was quickly communicated to the Hague, but the royal councils were divided in opinion. The only positive demand in Brussels was the dismission of the minister Van Maanen; and he offered to resign his post. The king is said to have refused accepting his resignation, whilst the Prince of Orange urged the acceptance of it, and the adoption of some other measures of a conciliatory kind. The result of the decision can only be known by the events which followed; and they show that neither the adoption of concessions, nor the positive use of force, was resolved upon, but a course was pursued which, being some undefined medium between the two different paths, ended, as was natural, in converting a mere popular riot into a confirmed revolution. It was determined by the council that the Prince of Orange should proceed to Brussels on a peaceful commission; whilst the command of the army was conferred on his brother, and the troops advanced with alacrity from the various parts of Holland, where they were quartered, and where the most astonishing zeal was displayed in support of the royal authority.

The prince, however, departed for Brussels, but only furnished with such limited powers as, in the actual circumstances, were utterly ineffective. On his arrival at Vilvorde, near the city, he was waited on by a deputation from the city, composed of some of the most respectable inhabitants, who had been nominated at a public meeting of the householders. After some preliminary discussions, the prince courageously resolved on entering the city with no other suite than a few officers of his staff. His passage through the streets, crowded with the irregular burgher guard, and a ferocious mob, was attended with imminent risk; but at length he reached his own palace, and commenced a conference. Discussions were continued for several days between the prince on one side, and respectable citizens on the other, which were conducted with firmness and in a conciliatory spirit by both parties. The substance was not a rejection of the royal authority, or of the reigning dynasty, on the part of the citizens, but a separation of the administration of Belgium from that of Holland. They all declared that no wish prevailed for any union with France, but only for such a kind of independence for both countries as had been fixed between Sweden and Norway, with which both countries were satisfied and benefited. It was more than intimated to the prince that the wishes of all Belgium would be fulfilled if he were elevated to the throne; but in answer to such suggestions he firmly asked of one of the most influential men both at that and the present time, "What opinion would you entertain of me were I to sacrifice the interests of my father to my own? What confidence could you repose in a man who could cast off his allegiance to his king, and that king his father, merely to gratify his own ambition? I also am a father," added the prince with deep emotion, "and am bound to show a proper example to my children. Posterity shall not revert to my name, and revile me as that disloyal Nassau who tore the diadem from his father's brow to place it on his own."

At a final meeting held on the 3d of September, when many members of the states-general attended, it was so fully obvious to the prince that nothing but a separate administration of the two countries would restore tranquillity, that he resolved to use his influence with his father to accomplish that object; and he received the fullest assurance from the persons present, that they would unite in the most efficacious measures to assure the dynasty of the house of Orange, and to protect the territory of Belgium against any attempts to subject it to France, or any other foreign power. The prince expressed his determination to use his most powerful arguments with his father to obtain his assent to this proposal; but expressed his apprehension that he should be unable to succeed in his endeavours. The prince then quitted the city, carrying with him the respect of all those with whom he had communicated, for the courage he had displayed, for the knowledge of public affairs which he discovered, for the cool judgment which he exercised, and, above all, for the sense of parental duty which he had manifested. Whilst these transactions were passing in Brussels, the whole country was in a flame; in every town the populace were triumphant, and indulged unre-

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strained in plunder, to which, especially in the important city of Liège, was added the conflagration of several valuable manufacturing establishments. The officers of the army, with no definite orders how to act, were paralyzed in some places, in others gave up their arms, and in others engaged to be neutral.

The king, amidst the general disorder in Belgium, and the most fanatical attachment to the royal cause in Holland, had summoned the states-general from both divisions to assemble at the Hague. The members from Belgium, with some slight hesitation, resolved to repair thither, and the assembly was opened on the 13th of September, by a speech from the king, which was firm and temperate, but by no means definite. The proceedings of this body were dilatory; the Belgium members were treated with indignity and insult by the populace; and the language of some of the Dutch members expressed vengeance rather than conciliation. The accounts received at Brussels from the Hague, and the warlike demonstrations made by the troops, rekindled and accelerated the preparations for defence, and induced some approaches to organization. The burgher guards had become tired of military duty, and being mostly tradesmen living on their business, which had now been ruined, they were anxious for the return of the tranquillity upon which their existence depended. The leaders of the opposition, however, drew fresh recruits of a more determined and more reckless description from the rude population of the Walloon provinces, from the men employed in the coal and iron mines, and from the iron forges and other works which had been destroyed or shut up in and around Liège. These were, in a great measure, old and hardy soldiers, who had served in the ranks of Bonaparte's army, and fought in Germany, in Russia, or in Spain. Their arrival in the capital spread terror amongst the peaceable inhabitants, and kindled alarms lest they should be again exposed to the outrages which had marked the first days of the explosion. The defenders were thus divided into two parties; but, as usual, the most violent soon prevailed; and the council of the rabble soon dispersed that of the burghers (for both had their separate assemblies), seized the arms of the latter, and added to them others which had been collected in different parts of the country.

Although the states were still sitting at the Hague, the king's army was gradually drawn around Brussels. It consisted of 14,000 well appointed troops, under the command of Prince Frederick. But the motions of this powerful body were so dilatory, and its whole operations so unmilitary, that they are difficult to be accounted for, unless on the supposition that the conduct of the king was too conciliatory when force should have been applied, and too hostile when conciliation would have been of most advantage to his cause. On the 20th of September the council resolved to take possession of Brussels, and orders were sent to Prince Frederick to that effect. This resolution was taken at the Hague in consequence of the information of numerous emissaries from Brussels, who represented the inhabitants as eager to receive the troops, and to assist in putting an end to the anarchy and oppression which the mob were exercising. The most respectable names in the city were appended to these representations, which were doubtless sincere, but came from such as were more prepared to enjoy the return of peace and good government than to contribute any share of their personal services to secure these blessings.

On the 25th, the troops advanced towards the city, and with little opposition occupied the upper portion or court part of it, which is situated on a hill, by which the whole of the rest of the town is commanded. The opponents in the lower part of the city were dispirited and disunited, and most of the more violent leaders had fled. But the commanders of the army seem to have been seized with a panic, or to have dreaded doing too much mischief to the houses and property of the more wealthy inhabitants. In the square, where the troops had been drawn up, they were exposed to a galling fire from an invisible enemy, who, from the roofs of the houses, and from the cellars, picked off the officers and men without being much exposed to any return from the troops. Instead of destroying the houses and buildings which concealed the assailants, the prince had recourse to unavailing negotiations, and, after three days of most harassing service, determined to withdraw his troops. He had the means of stopping all supplies from entering the city, and thus of effecting a surrender by starvation; or, by a bombardment, he might have easily enforced submission. Why neither of these means were adopted cannot be certainly known; but the friends of the royal party attribute it to humanity alone. The loss of lives was not very great on the side of the king's troops, considering their exposed situation, and the number engaged. It is stated in the returns as 138 killed, and 650 wounded; whilst of the defenders of the city, though far inferior in numbers, the casualties were acknowledged by themselves to be 450 killed, and 1250 wounded. This disparity must be considered as one of the many extraordinary circumstances of the transactions, and renders the result utterly incomprehensible. The incredible intelligence of this repulse was rapidly conveyed to the provinces, with great exaggerations; and disaffection, anarchy, and demoralisation were spread everywhere. The army retreated towards Antwerp, which, in spite of the force near it, soon became involved in confusion. Ghent, Bruges, Ostend, and the other towns in that direction, immediately became a prey to the revolutionary party, and experienced the horrors of anarchy in the destruction of some of their most extensive manufacturing establishments. The universal rejoicing of the Belgians did not prevent some measures from being adopted to restrain outrages. In a few days, some individuals, with the general acquiescence, formed themselves into a provisional government. They were for the most part men of character and property; but amongst them was De Potter, who had returned as soon as the danger was over, and had been placed by the popular feeling at the head of the body. His power was but of short duration, and he soon fell into utter insignificance, if not contempt, as did others of the original leaders of the insurrection. When those of the representatives who had assembled at the Hague returned home, and their conduct was reviewed in a dispassionate manner, the weight of their character gave them an influence which proved favourable to the return of order. Some of them were added to the body forming the provisional government, and they exercised their influence with prudence, firmness, and integrity.

In the provisional government the state of parties was singular, from the variety of opinions. De Potter, who looked forward to the dignity of president, advocated a republican form of government; Gendebeer, a decided advocate of democracy, preferred a union with France; whilst Van de Weyer wished for an independent government, on a monarchical basis, with the Prince of Orange at the head, if he would consent to withdraw altogether from his Dutch obligations, and become exclusively the sovereign of Belgium. The plan of Van de Weyer was known to be favoured by all the kings of Europe; and even France, at that moment under the pilotage of Lafayette, was averse to the entire exclusion of the Nassau dynasty, and sent an agent to Brussels to forward his views. Gendebeer had visited Paris, and there found little or no disposition amongst the leading people to agree to a union with the Belgians, which, they were aware, would involve them in a war with all those powers that had founded the kingdom of the

Netherlands in 1815, solely as a European object and a barrier against France.

It soon became evident in Belgium itself that republicanism had made little or no progress. The prevailing opinion was strong in favour of the Catholic religion, with all its ancient powers and observances, but stronger still in favour of a nationality independent of all foreign control. This latter spirit contributed to increase the number of those who had taken up arms; and by such persons the repulse of the Dutch at Brussels was vainly considered as an evidence of the military power of the people. Many of the privates, and a few Belgians of distinction, had been in the army of Prince Frederick; but they soon left his colours, and entered the ranks of their countrymen. The Belgian colours waved on every tower in the country, except those of Antwerp and Maestricht; when the Dutch army, greatly reduced in numbers as regarded subalterns and privates, but with the artillery in complete order, withdrew into their own territory.

The council of the king at the Hague resolved on the separation of the two governments into different administrations; but it was then too late to produce reconciliation; and an attempt made by the Prince of Orange to procure for himself the supremacy of Belgium had no other effect than to beget contempt in that country, and to draw upon himself the temporary suspicion of double dealing towards his father and his countrymen in Holland.

The transactions which took place at Antwerp in October had the further effect of rendering the Belgians still more adverse to the Orange dynasty than they had before been. That city was invested by a Belgian force, whilst within, notwithstanding the resistance of the armed burghers, the populace became masters of the place; and the citadel was occupied by a garrison of 8000 good troops, commanded by the bravest of the Dutch officers, General Chassé. A truce had been concluded between the adverse parties, and a white flag hoisted from the fort; but the Belgian officers were unable to maintain it, the populace having begun an attack on the citadel, though with no other arms than muskets. This was not returned, but a cannon was brought forward by the populace, and a fire opened on the gates of the citadel, which, as the Belgian officers assert, was without their approbation or knowledge. On this infraction of the truce, Chassé ordered two or three guns to be fired from the bastion facing the arsenal. This being found ineffectual, the white flag was taken down; a signal was made to the fleet, consisting of eight vessels of war, in the Scheldt, close to the town; and a cannonade and bombardment commenced. It was more terrific than injurious, the fire being chiefly directed against the arsenal and the entrepôt, where all the military and naval stores in the former were destroyed; whilst in the latter large quantities of sugar, coffee, hides, cloths, silks, and spices, were burned and buried in the ruins of the storehouses. The firing had continued some hours when a deputation from the city made their way to the citadel, and proposed a suspension of hostilities, which was instantly agreed to, and the firing ceased. Never, perhaps, was exaggeration or misrepresentation carried farther than on this occasion, in the reports printed and circulated through Belgium; and the effect which they produced destroyed the last hope of those who wished well to the Orange dynasty. Since that event, official accounts made out by the Belgian custom-house show, that the whole loss of goods in the stores amounted to 1,888,000 florins, or L.157,200; whilst the damage done to private buildings, and the furniture in them, amounted to 679,466 florins, or L.59,450. In this the loss of the public buildings was not included. The number of the killed was only sixty-eight, of whom seventeen were military men, and the others those of the populace who had caused the calamity. The Dutch asserted that the fire was confined almost wholly to the spot where the munitions of war were stored, and that the rest of the city was designedly spared.

As all hope of conciliation was thus destroyed, the court of the Hague made pressing solicitations to the four powers who by treaty had formed the kingdom of the Netherlands, to fulfil the obligations imposed upon them by the treaty of Vienna of 1815. But it was soon seen by the answer of Lord Aberdeen, the British secretary of state, and by those of the ministers of the other powers in succession, that none of them was disposed to make use of any other than pacific measures. This proceeding gave rise to negotiations between the allied powers, which were chiefly carried on in London, out of which proceeded numerous protocols, which had no decisive influence on the course of events. The public affairs of Europe favoured the independence of Belgium. All the powers were in alarm at the recent events in France, and all feared, not that the scarcely seated king would willingly commence a war of aggression, but that the democratic party might become sufficiently powerful to compel him to associate himself with the Belgians, and to bring that country under the power of France. The obvious interest of the four great powers was tranquillity, and the securing of the Continent against Flanders becoming the base of military operations towards the centre of Europe. If these could be obtained, it mattered little whether they arose from the junction or the separation of the two portions which had formed the kingdom of the Netherlands. The first meeting of the ministers of the great powers showed that they merely considered themselves as arbitrators between the northern and southern divisions of the newly-dissolved kingdom; and their first measures were addressed to the object of a suspension of hostilities, which was to a limited extent acquiesced in by both parties.

To settle the internal government now became the first object of the Belgians, who considered their independence as firmly assured. A national congress was accordingly assembled at Brussels, consisting of two hundred deputies, chosen in the several provinces, from all tax-paying persons above twenty-five years of age, without exception as to religion. The qualification for the electors and the elected was the paying of taxes, which varied in the several provinces according to their estimated wealth. Thus, in Luxembourg, the poorest province, the qualification was the payment of taxes annually to the amount of twenty-one shillings and sixpence; but from this the required rate was gradually raised, till, in Flanders, the richest of the provinces, the tax paid required to be six pounds five shillings. The assembly was a fair representation of the people of Belgium; for scarcely any proprietor was excluded from voting, whilst in the larger towns and cities the mere populace, from the qualification being higher, had not the means of introducing their favourites. As soon as the assembly met, the demagogues, who had contributed to the revolution, became insignificant. De Potter, Thielman, and the others who had been martyrs and heroes with the mob, sunk into insignificance.

The assembly proceeded to business in a regular manner. Three important propositions were presented to the congress. The first was the declaration of independence, which was voted unanimously; the second, proposed on the 22d of November, decided against a republic, and in favour of a constitutional hereditary monarchy, by a majority of 174 against thirteen votes, but it did not fix on the title of the future chief of the state; the third proposition, brought forward on the 23d, was for the perpetual exclusion of the Orange Nassau family. This was debated during two days, and at the close was agreed to by a majority of 161 against twenty-eight. The object of the minority was to delay the proposition till a more cool and distant period, and till it could be known whether the revolution which had taken place would lead to a war against Belgium. Mr Van de Weyer had, however, returned from a mission to London,

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and it was commonly believed he had ascertained that the sentiments of Lord Grey and the new ministers were as averse to any warlike interference as those which had been previously expressed by the Duke of Wellington and Lord Aberdeen.

It seems probable, that at the period in question the governments of England and France were co-operating in endeavours to place the Prince of Orange on the throne of Belgium; even if it could be accomplished in defiance of the positive declaration of the king his father, who did not scruple to assert, "that he would rather see De Potter placed on the throne than the Prince of Orange." But if such was the desire of the two kingdoms, it was soon discovered to be utterly impracticable, though much time was spent under the impression of its feasibility, and much suspicion excited amongst the Belgians against the sincerity of France.

Whilst the plenipotentiaries were settling the most equitable plan for separating the two countries, and had given their view with respect to the boundaries of each, they also adjusted what portion of the debt of the Netherlands should be assigned to Belgium, and what to Holland, fixing the former at $\frac{16}{31}$ parts, and the latter at $\frac{15}{31}$ parts. These discussions led to others; and it soon became known, that however independent Belgium might become as regarded Holland, it was too dependent on the superior power of the European kingdoms to be permitted the spontaneous nomination of the individual who was to become its sovereign. At that time a large, perhaps a predominant, party in the assembly would have preferred one of the Bonaparte family; but this, it soon appeared, would not be permitted by France. Another party were inclined to select a son of Louis Philip, the king of the French; but intimations had been communicated to that prince, that England would consider an acquiescence in the project as a sufficient cause of war; and he agreed to the exclusion of his son, but so privately that it was only known to a few individuals beyond the diplomatic circles. The partisans of the house of Orange took no open and avowed part in these discussions.

The inefficiency of this representative assembly to the real purposes of a government was speedily shown in the long and bombastical speeches of the members; in the absolute confusion in every department, whether civil, military, or judicial; and in the mobbing and plundering which prevailed in all the provinces. The necessity for an executive power was so strongly felt by the more reflecting members of the assembly, that after several days' preparatory debate, it was resolved, on the 19th of January 1831, to proceed to the election of a chief on the 28th of that month. The election of a sovereign, or rather of a dynasty, was enough to kindle agitation and intrigue; but perhaps less of these than might have been expected was discoverable, from the great number of the candidates whose pretensions were urged. On the day before the election, petitions were presented to the assembly in favour of Lafayette, Fabvier, Chateaubriand, the Prince of Carignan, the Archduke Charles; Surlet de Chokier, Charles Rogier, and Felix de Merode, private Belgians; Prince Otho of Bavaria, John duke of Saxony, a Prince of Salm, the Pope, the Duke of Nemours, second son of Louis Philip, and the Duke of Leuchtenburg. Besides these, the Duke of Lucca, the Duke of Reichstadt, the son of Napoleon, and the Prince of Capua, brother of the king of the Two Sicilies, were suggested. The choice of the last was seriously contemplated by the French, through Talleyrand; but the Belgians showed no predilection for him, although he was not objectionable to any of the four powers. Had the Belgians showed any decided eagerness for Prince Otho of Bavaria, it was known that he would have been recognised by England, France, and Prussia; and that he would then have obtained the hand of the Princess Mary, third daughter of the king of the French. But his age, for he was only fifteen, formed an objection with the Belgians. The popular press, decidedly democratic, was most united in favour of the Duke of Leuchtenburg; but its power had been used till it was exhausted; and, besides, the choice was in better hands than those who are influenced by its inflammatory declamations. It is remarkable, that amongst the long list of candidates the name of Prince Leopold was never once mentioned. It has been suggested that England had not even then abandoned the hope of fixing the Prince of Orange on the throne. This would have been approved of by Russia, Prussia, and Austria, and by the nobles and wealthier part of the Belgians, but not by France, as Louis Philip was disposed to fear that the example of enthroning the son of the deposed monarch might hereafter have been taken as a precedent in favour of the Duke of Bordeaux against his son in France.

At the eve of the election, however, by some strange caprice of circumstances, all the names were withdrawn excepting the two, who, all intelligent persons knew, could not be allowed to rule. It was remarked of them by Northomb, one of the most respectable of the democratic members, that "the Duke of Leuchtenburg was essentially anti-French, without being European, whilst the Duke of Nemours was so exclusively French as to be directly anti-European." It is singular that both these personages had been declared inadmissible by the conference of the representatives of the great powers. The name of the Archduke Charles of Austria was then brought forward; but he could only be considered as a cloak for the partisans of the Prince of Orange, and for other members, who knew he would not accept the dignity, for the purpose of reducing that absolute majority of the whole voters which was necessary to the choice. The votes were taken by ballot, and the following result appeared when the names were drawn from the urn:—The total number of voters was 191, and consequently the required absolute majority was ninety-six. Nine members being absent, there appeared for the Duke of Nemours eighty-nine, for the Duke of Leuchtenburg sixty-seven, and for the Archduke Charles thirty-five, so that, in fact, there was no election. A new voting then became necessary, and the second scrutiny gave a definite result. Another member had entered, making 192, and consequently the absolute majority required was ninety seven. The state of the voting then appeared to be, for Nemours ninety-seven, for Leuchtenburg seventy-four, and for the archduke twenty-one. This annunciation was received with acclamation by the populace, and with expressions of joy by the partisans of the successful candidate, who well knew his father would not permit him to accept the offered crown. A deputation was despatched to Paris to announce the choice. But the throne was refused, and the deputies returned after paying and receiving some unmeaning compliments.

The moment was seized by the partisans of the Prince of Orange in order to raise a commotion in his favour. It was a wild project, confined to Ghent, Bruges, and Antwerp, where his adherents were numerous, especially amongst the lower class, who had been thrown out of employment by the cessation of commerce and manufactures. The attack on Ghent was speedily quelled, and the leader fled; but he was seized on his way to France, and on his person were found letters from the Prince of Orange, then in London, encouraging the project. This unsuccessful effort, and the evidence of the prince's participation in it, proved very injurious to his cause; and even sober men who had favoured him, were disgusted with what appeared to them to be an attempt to involve the country in a civil war.

On the refusal of France, the assembly, still feeling the want of an executive power, passed an act that the throne was vacant, thereby establishing the monarchical principle, and then proceeded to the election of a regent as a temporary measure. The choice fell upon Baron Surlet de Chokier, a worthy, well-meaning man, of no great abilities, who showed little solicitude for the dignity; and on the 25th of February he was installed with some parade. Plots and conspiracies were forming around him in every direction, and the demon of civil war was urging on the people to mutual destruction. The feeble government of the regent could produce neither obedience nor tranquillity within the country; and it was threatened by the Dutch, who adhered to their king and his purposes with equal union and ardour. It was reported, during the regency, that schemes for the dismemberment of Belgium were contemplated by some of the continental powers. According to this project, two thirds of Flanders, the province of Antwerp, and the northern half of Limburg and Brabant, including Brussels, would have fallen to Holland; the eastern part of Luxembourg, with Liège and other territories upon the left bank of the Meuse and the Moselle, would have been transferred to Prussia; and Namur, Hainault, and the west part of Flanders, would have been ceded to France. If this project was seriously entertained, it received such discouragement from the British government, that it was speedily abandoned. About the same period, that is, about a month after the instalment of the regent, extensive plans were formed for a general rising amongst the Orange party, in connection with some of the chief officers of the army and the most influential leaders of the burgher guards of Brussels. But this came to nothing, having, it is said, been discountenanced by the British minister at Brussels, who saw no other effect that could arise from it but a general European war. It is said that after some discussion respecting Luxembourg, and checking the petty hostilities on the frontier, the British government in April gave up all hope of establishing the Prince of Orange on the Belgic throne. On the 12th of that month a kind of proposition was made by some of the influential members of the assembly, and privately communicated to Sir Edward Cust, one of the equerries of Prince Leopold, with the design of ascertaining whether the prince, if chosen, would accept the crown. Leopold answered in the affirmative, but strictly abstained from giving any authority to make exertions in his favour. He was however convinced, before the election, that a vast majority of the electors would vote in his favour; and that he should have all the aid of the clergy and the high Catholic nobility, with no opposition but from the French and movement party, and the few Orangeists that had seats in the assembly. A deputation of four members repaired to Claremont, and had an interview with the prince. They explained their object, and the conditions upon which they were authorized to offer the crown, and awaited his reply. It manifested a noble, simple, and frank disposition, and concluded thus: "All my ambition is to contribute to the happiness of my fellow-creatures. When yet young, I found myself in so many difficult and singular situations, that I have learned to consider power only with a philosophic eye. I never coveted it but for the sake of doing good, durable good. Had not certain political differences arisen, which appeared to me essentially opposed to the independence of Greece, I should now be in that country; and yet I never attempted to conceal from myself the difficulties of my position. I am aware how desirable it is that Belgium should have a sovereign as soon as possible. The peace of Europe is deeply interested in it."

The deputation returned, and many stormy discussions ensued. Attempts were made to defer the election till all differences with Holland were settled; but these were overcome by the votes of 137 to 48. The election took place on the 4th of June, when 152 votes out of 196, four only being absent, determined that Prince Leopold should be proclaimed king of the Belgians, under the express condition, that he "would accept the constitution, and swear to maintain the national independence and territorial integrity."

This choice, though not expressly unanimous, was such in reality; for of the minority of forty-three, nineteen voted on the ground that the election was premature, fourteen voted for Baron Surlet de Chokier, solely on account of private friendship, and thus the real opposition to Leopold consisted only of ten. Though the voting was by ballot, yet the vote of every man was known; and all who dared, gave reasons for it, except the ten, who were well known as terrorists.

Leopold lost no time in repairing to the post to which he was appointed, and, with only one aide-de-camp and a few domestics, landed at Ostend on the 17th of June, and proceeded directly through Ghent to the palace of Lacken, near Brussels. He made his public entry into that city on the 21st, and was received with cordiality by the higher classes, and by the populace with loud acclamations. The king took the oath to the constitution; the regent delivered up his power; and the congress was dissolved, to make way for the election of the members who were to form the two legislative chambers, as prescribed by the fundamental laws.

The first chamber, or the senate, was to consist of fifty members, chosen for eight years, but one half of them was to be renewed at the end of four years. The qualifications were to be, having attained the age of forty years, and paying direct taxes to the amount of 1000 florins, or L.84 yearly. The second chamber was to consist of 101 members, being at the rate of one for 40,000 inhabitants. They were to be of the age of twenty-five years, to pay annual direct taxes to the amount of L.8, and to be paid at the rate of 200 florins, or L.16, each month during the session. They were to be renewed by one half retiring at the end of two years, but they might be again elected.

After a few formalities, and appointing the ministers to compose the cabinet, on the choice of which much judgment was exercised, the king left the capital to visit Antwerp, Liège, and the other parts of the new kingdom, and was everywhere received with demonstrations of respect and of loyalty. But whilst the proceedings just narrated were passing in Belgium, a storm was gathering on the side of Holland, which had not been anticipated, and to meet which no adequate preparations had been made. The Belgians relied on the armistice which the conference of the ambassadors had established, and the few measures which were taken by them discovered only the confusion and disorder inseparable from all popular movements. In Holland, every thing betokened tranquillity, order, and loyalty. The different orders of the government and the people were more eager for punishing what they denominated the rebellion, than even the king and his family. A powerful army was quickly assembled. It was well disciplined, officered, and appointed, and furnished with an ample train of artillery; and yet all was done with so much secrecy, that till that army was ready to advance beyond the frontiers, no preparation was made to resist it.

Much dispute has arisen relative to the right of Holland to commence hostilities without due notice of the cessation of the armistice; but, on the other hand, Holland maintained that due notice had been given. The whole turned on the precise sense of the words "ses moyens militaires," in a note delivered by the Dutch ministers to the conference of ambassadors. The king was certainly encouraged in the enterprise by the stormy scenes exhibited in the Belgian assembly between the period of Leopold's election and the time of his arrival. By the noxious influence of the press, such angry passions had been kindled in every

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division of society, as seemed to threaten internal war; but happily a most powerful speech of Mr Lebau in favour of union, and urging the importance of rallying round their new monarch, had the effect of producing feelings of tranquillity; though no language had power to produce order or infuse energy, when the time approached for the exhibition of the one and the exercise of the other.

The Prince of Orange having assumed the command of the Dutch army at Breda, on the 1st of August, the order to advance was instantly given; and the march of the several divisions commenced the next day. This was a complete surprise to the Belgians, who were unprepared at every point to resist a disposable army of more than 40,000 men. It is not necessary here to describe the position and the movements of the various corps on both sides. It was, however, remarked by military men, that the Prince of Orange advanced more deliberately than the occasion required. Leopold collected his forces, such as they were, near Louvain, in order to cover his capital. In this position the Dutch army, having seized the road which led to Brussels on the 9th of August, advanced to attack him. The Belgian troops could not stand for a moment against their opponents, but instantly fled, throwing away their arms, and escaping in disorder; and a neglect of the Dutch, who thoughtlessly left open a road behind Louvain, alone prevented Leopold and his whole staff from becoming prisoners of war. He, however, made good his retreat to the capital, upon which all hostilities ceased. As soon as the movements of the Dutch were known, Leopold appealed to France for assistance. A French army was cantoned on the frontiers, which, by telegraphic communications, was instantly set in motion; and intelligence of their advance was formally announced to the Prince of Orange by Lord William Russell, coupled with an intimation, from the French marshal Gérard, of the determination of the two powers to enforce the abandonment of all military operations. As the French army rapidly entered the country, the Prince of Orange soon saw the necessity of retreating; and a convention was concluded between him and the French general, in consequence of which he returned to Holland, and the French repassed the frontier; so that by the 1st of September both armies had left the Belgian territory.

The cowardly disgraceful conduct of the Belgic troops was of great benefit to the new government. It showed the reflecting part of the community the folly of trusting the defence of their country to a host of popular partisans, too ready to destroy or to plunder, but too much inflated by the flattery they bestowed on themselves to become efficient defenders when steadily opposed. All saw the necessity of confiding in their chief, and became convinced that a regular army must be formed, in which the men should be compelled to obey their officers. The formation of an army was therefore determined on; but Belgium could not furnish officers. Most of those appointed had been placed in stations of which they were unworthy, because they had been what was called distinguished patriots, that is, leaders of the revolutionary movements; but those active disorganizers were found worse than useless when energy against an enemy required order, discipline, and obedience. By the interference to protect Belgium against Holland, this farther advantage was gained, that the protecting powers were placed in a position to obtain more weight in the negotiations carried on in the conferences of the ambassadors, and both parties were more disposed to leave the contested points respecting boundaries to their arbitration.

In forming an army, Leopold was assisted by the French, who, as far as could be done, furnished it with able officers; a want which Belgium could by no means supply from the natives of that country. The partisans of the Orange family, on this occasion, justified the conduct of King William previous to the revolution, in having selected few of his officers from the Belgians. The selection of Frenchmen, they contended, proved that William was right in not trusting to officers taken from that division of his kingdom.

After the Dutch irruption, Leopold proceeded with coolness and vigour to restore order and gain confidence. He kept on the best of terms with the most important party, the Catholic clergy and the Catholic nobility, and avoided any nearer contact with the French party than politeness and civility required. He knew who were the real friends of monarchical government, and his best supporters. His marriage with a daughter of the king of the French, who was a Catholic, and the contract that the children of the marriage should be educated in the Catholic faith, were powerful means of attaching to his throne all those of his subjects who were under the influence of the clergy. The Belgian army, under the French officers, soon attained considerable advancement in organization and discipline. The undisciplined free troops were disbanded, and the best of the men incorporated in the regiment of chasseurs. Some superior officers were superseded, and many of the subalterns dismissed. A military school was established, and a corps of sappers and miners with a pontoon brigade raised.

The civil list was arranged with economy and order, and the other branches of the public service reformed, and others newly arranged. The talents and the integrity of Leopold, and his benevolent disposition, made a very favourable impression on all that approached him.

Whilst affairs were thus proceeding within, the great work of general pacification was attended to by the members of the conference in London. A final decision was come to on the 15th of November, expressed in twenty-four articles. These settled the great point of boundaries, and placed the question of Luxembourg in a way the most favourable, as was thought, for future pacific arrangement; but, above all, it expressed a determination "to oppose, by every means in their power, the renewal of hostilities between the two countries." This arrangement was ratified by the Belgian and French sovereigns on the 20th and 24th of November, by the British on the 6th of December, by Austria and Prussia on the 18th of April 1832, and by Russia on the 4th of May.

By these articles, the division of the joint debt was fixed on the scale before arranged, viz. $\frac{16}{31}$ for Belgium, and $\frac{15}{31}$ for Holland; but as the latter had discharged the whole interest as it became due from the first disturbances, she was to be paid the share of the advances, with interest on them at the rate of five per cent. Another point arose out of the settlement of the limits of the two countries. Holland was to have Maestricht, and was in actual possession of that place and its citadel; but Antwerp, which was allotted to Belgium, and was in possession of the Belgians, was commanded by the citadel, which was garrisoned by a Dutch army under the command of General Chassé, a distinguished officer, who, after the annexation of Holland to France, had served in the army of the Emperor Napoleon. The Belgians had given only a conditional ratification of the articles of the 15th of November, upon the express stipulation that the whole of them, in which the possession of the citadel of Antwerp was certainly included, should be fulfilled. They were precluded by that instrument from exercising hostilities, and therefore claimed from the parties to it the performance of its conditions.

It was important to the allied powers that the throne which they had established in the person of Leopold should be strengthened in the views of his subjects, who had sometimes manifested dispositions to democracy, and at others strong inclinations for a union with France, neither of which were deemed compatible with the interests of the European commonwealth. But it could not retain respect if the conditions framed by the founders were to be impugned by the Dutch holding the citadel of Antwerp, whilst they were still in possession of Maestricht. These considerations had their due effect on the conference, who, on the 1st of October, unanimously resolved that forcible means were necessary. They differed in regard to the means, the northern courts wishing to adopt pecuniary coercion, by deducting from the debt due from Belgium to Holland a sum weekly till the fortress was delivered up; but to this France and England objected, as leading only to future and tedious negotiations, during which Rotterdam and Amsterdam might enjoy those exclusive commercial advantages which Antwerp was entitled to share with them.

Belgium, being wearied with these entangled negotiations, and having now created an army of more than 100,000, gave notice that, unless their territory was evacuated before the 3d of November, they would use force to compel it. But this would have created a war, which all the powers were anxious to prevent. On the 22d of October, a convention was therefore entered into between England and France, which was forthwith communicated to the three other powers, of whose passive adhesion they were assured.

By this convention it was determined, that if the places assigned by the former resolutions to the respective parties were not given up before the 12th of November, France and England would enforce the delivery of these places. This determination was communicated to both nations. Belgium was ready to give up Venloo, which she held; but Holland positively declined surrendering the citadel of Antwerp. The result was, that a combined fleet of English and French proceeded to blockade the ports of Holland, and detain the merchant-ships, whilst France prepared an army to besiege the citadel, without allowing the Belgians in any way to interfere in the military operation. The siege of Antwerp by the French, as a fine practical exemplification of science, became an object of great interest to the military amateurs of all Europe, who repaired thither as spectators. But this is not the place for recording the history of that warlike spectacle. It was vigorously and skilfully attacked; and the defence, which was altogether passive, exhibited a conspicuous example of fortitude and endurance. The first works of the besiegers were opened on the 30th of November, and on the 24th of December the citadel capitulated, when the garrison marched out, and the French took possession of the battered fortress, which, on the 1st of January, they delivered up to the Belgians. The city of Antwerp was not in the least injured, as the approaches were carried on upon the opposite side. The French army shortly afterwards withdrew from Belgium to its own territory. The Dutch garrison was marched into France as prisoners, on the ground that two forts on the river Scheldt, those of Lillo and Liefenschoeck, were still retained by the Dutch. This led to long and complicated diplomatic negotiations, which were at length adjusted, when the captured garrison returned to their own country. Since that period no hostilities have taken place; but, on the other hand, no treaty has been entered into, and consequently no intercourse between the two countries has been permitted.

Belgium has at length been acknowledged as an independent power by most of the states of Europe, but only provisionally by some of them. Many of the owners of ships, especially of those of the first class, have withdrawn their concerns from Antwerp and Ostend, and formed establishments in Rotterdam and the other parts of Holland. Of these removals, not a few have been caused by the colonies appertaining exclusively to Holland. But this withdrawal has had less influence on the marine commerce of the Netherlands than might have been expected; for British and American ships have brought to Antwerp colonial produce, on quite as favourable terms as they were before supplied, and in sufficient quantity to enable the Belgians to maintain their commerce with the interior of Germany.

Attempts are now in progress to bring Antwerp in communication with the Rhine. But, on the part of the Prussian government, these have encountered some obstacles, not from any disinclination to the work, but from doubts as to the particular line to be followed, and some financial circumstances respecting the tolls. If the projects in question be accomplished, the Belgians will be much benefited, and have the power of supplying produce to the south of Germany, and also to Switzerland.

The manufacturers have suffered much from the separation, especially those of Ghent. But a trade has grown up to a wonderful extent, of smuggling English goods of the finer kind into France, which the numerous douaniers have not been able to prevent along such an extended line of frontier.

Agriculture, which, after all, is the chief source of Belgian wealth, does not appear to have retrograded in consequence of the struggle of the separation. On the contrary, it appeared to the writer of this article, in two journeys which he made through the country, that much improvement was visible in the appearance of the farms, and in their appurtenances.

This kingdom, in the condition in which it now exists, is bounded on the north by the kingdom of Holland; on the east by the Prussian, Westphalian, and Rhenish territories; on the south by France; and on the west by the German Ocean.

The civil divisions of the kingdom are as follow.

Provinces.	Extent in Square Miles.	Population.	Capitals of the Provinces.
South Brabant.	1,298	556,146	Brussels.
East Flanders...	1,188	733,938	Ghent.
West Flanders.	1,276	601,704	Bruges.
Antwerp.........	1,128	354,974	Antwerp.
Hainault.........	1,474	604,957	Mons.
Namur...........	1,422	212,725	Namur.
Liège............	1,421	369,937	Liège.
Limburg.........	1,128	337,703	Limburg.
Luxembourg...	1,194	292,151	Luxembourg.
	11,529	4,064,235	

As the above statement is taken from the official returns of the Belgian government, the disputed portions of Limburg and Luxembourg are included in that kingdom, although still subjects of discussion. The number of the inhabitants is given according to the census of the year 1830, since which the number must have increased. The tables of the population annually furnished by Smits to Quetelet show an excess of births over deaths of 20,000 persons in each year, and consequently the whole population may now (1837) be taken at 4,200,000. Of the population at the census of 1830, the numbers in the cities were about one fourth of the whole: they amounted to 998,118, whilst the rural inhabitants were 3,066,117.

The cities which contain more than 10,000 inhabitants are,

Brussels	103,200	Courtray	19,036
Ghent	83,783	St Nicholas	16,386
Antwerp	77,199	Lokeren	16,069
Bruges	42,198	Ypres	15,940
Tournay	28,737	Alost	14,791
Louvain	25,643	Lierre	13,153
Mechlin	24,436	Turnhout	12,493
Mons	23,010	Thielt	11,519
Namur	21,571	Ostend	11,328
Verviers	19,592		

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The following division of the land is drawn up by Mr Quetelet, with his usual accurate examination of facts.

Provinces.	Cultivated.	Uncultivated.	Land Built on.	Roads, Canals, and Rivers.	Total.
Limburg	310,514	139,410	1,480	15,283	466,687
Liège	237,579	40,850	915	9,648	288,992
Namur	278,397	58,959	926	9,401	347,683
Luxembourg	463,423	167,760	1,462	17,571	650,216
Hainault	356,258	3,455	2,962	9,794	372,469
Brabant	316,883	1,356	1,768	8,419	328,426
East Flanders	264,988	1,310	4,422	11,641	282,361
West Flanders	296,915	8,690	2,015	8,965	316,585
Antwerp	197,303	72,651	1,719	12,157	283,830
	2,722,260	494,441	17,669	102,879	3,337,249

This account is framed in the hectolitre of France, each hectolitre being somewhat more than two English acres and a quarter.

From the proportion which the rural inhabitants bear to those in the cities, it may be concluded that agriculture is the chief pursuit of the kingdom. It becomes, therefore, a branch of industry of the most interesting kind.

The land of Flanders is not naturally fertile; on the contrary, its quality is merely such as to admit of fertilization by a series of operations more or less expensive and laborious. Where cultivation has not been extended, the soil produces nothing but heath and fir. As the property of such lands may be acquired for a very small sum, many individuals have attempted to bring portions of it into cultivation, but have almost uniformly found the expense of doing so to exceed the value of the produce which can be drawn from it. Abbé Mann, to whom we are indebted for some valuable communications on the subject of Flemish agriculture, observes, "What land is cultivated in the Campine of Brabant, is owing to the religious houses founded in it, especially to the two great abbeys of Tongerloo and Everbode. Their uninterrupted duration for five or six hundred years, and their indefatigable industry, have conquered the barren harsh sands, and rendered many parts of them highly productive. The method they follow is simple and uniform; they never undertake to cultivate more of this barren soil than they have sufficient manure for; seldom more than five or six bunders (fifteen or eighteen acres) in a year; and when it is brought, by labour and manuring, into a state capable of producing sufficient for a family to live on, it is let out to farmers on easy terms, after having built them comfortable habitations. From the undoubted testimony of the historians of the Low Countries, it appears that the cultivation of the greater part of these rich provinces took its rises from the self-same means, 800 or 1000 years ago, when they were in a manner one continued forest." Although, from the destruction, dispersion, or diminution of the religious communities by the French Revolution, the process of reclaiming other parts of the heaths has been suspended or rendered languid, yet the excellent agricultural practices, which a long series of years had ingrafted into the minds and habits of the sluggish peasantry, have been adhered to with a tenacity which is obviously distinguishable in all the other customs, as well as in the manners, dress, food, and religion of the people. Besides that general system of economy which is indispensable to the success of all efforts, and which there enters into the minutest details of husbandry, the two great objects which seem to be aimed at in all their operations are the increase of those crops which afford sustenance for cattle, and the careful preservation of every substance which can be converted into manure, and returned again to the land, in order to renew its exhausted fertility.

The foundation upon which the agriculture of Belgium rests is the cultivation of clover, which seems indigenous, since none of the most ancient records notice its introduction, but speak of it as familiarly as of hay or oats. It is probably from this country that the plant in question has been, though but recently, slowly, and hitherto only partially, introduced amongst the farmers of Germany, France, and Great Britain. The clover in Flanders is sown in every sort of grain, in wheat, rye, and winter barley, in the spring of the year, when the blades of those plants have acquired a growth of three or four inches; and with oats and summer barley at the same time with those seeds. It is also often sown with flax; and, in general, the crops grown between those plants are more luxuriant than when sown with the cerealia. It frequently happens, when sown with flax, that clover yields a heavy crop a few months after it is sown, two still more abundant crops the next year, and sometimes even three; and if, as it occasionally happens, it be suffered to stand another year, it will yield one heavy crop, and afterwards good pasture for cattle, till it is ploughed up to receive the seed of wheat, which usually follows it. The original strength of the plants which yield such abundant nourishment is undoubtedly due to the care taken in pulverizing the soil by frequent ploughings and harrowings, to the careful extirpation of all weeds, and to the copious stores of manure laid on the ground, and its complete amalgamation with the soil; but the successive harvests which the plants yield are attributed, and with apparent probability, to the top-dressings which are bestowed upon them. The top-dressings administered to the young clover consist either of rotten yard-dung, lime, pigeons' dung, coal, or native turf-ashes, and are laid on as soon as the plants begin to extend themselves over the ground. Sometimes the plants are refreshed with a liquid manure, which will hereafter be noticed. These manures, though administered to the clovers, as far as they can be obtained, are found far inferior in powers of fertility to that substance which is most generally used, and the effects of which form the theme of the praises bestowed by all who have witnessed the Belgian husbandry. The turf-ashes of Holland are sown by the hand on the clovers, in quantities varying from eighteen to twenty bushels to the English acre. This small quantity produces a most surprising, and almost magical effect. Within a few weeks after it is sown, a field where none or but slight straggling plants were to be seen becomes covered with a most abundant herbage. The parts of a field sown with these ashes, at the first mowing, show their efficacy in a most striking manner; the clover being frequently a foot higher on such parts than on those where its sowing has been omitted. These ashes are found superior in efficacy to such as are made from the turf commonly used for fuel in Flanders, insomuch that one third of the quantity is deemed sufficient to afford as great productiveness. We have no analysis of the turf-ashes of

Flanders, by which we can form a comparative estimate of the proportional substances which create so vast a difference between their vegetative faculties and those of the turf-ashes of Holland. The latter have been carefully analyzed by Mr Brande, secretary to the Royal Society of London, who found them to contain,

Siliceous earth	32 parts.
Sulphate of lime	12
Sulphate and muriate of soda	6
Carbonate of lime	40
Oxide of iron	3
	93
Impurities and loss	7
	100

These ashes are brought from Holland by the canals to Brussels, whence they are conveyed by land-carriage to the different farms where they are applied. Long practice has so convinced the Flemish farmers of their benefit, that a common proverb, in the patois of the country, may be thus translated: "He that buys ashes for his clover pays nothing, but he who does it not pays double." They are frequently fetched from the canal by persons who have to carry them forty or even fifty miles by land.

The abundance of the clover produced from the soil of Flanders enables the cultivator to maintain a great number of cattle, principally cows, the dung of which is managed with an attention and care that is highly worthy of imitation, and contributes to maintain in a state of high fertility that soil which yields the most exhausting crops. "The farmers," says the Abbé Mann, "supply the want of straw in the following manner: The peat or sods which are cut from the heath are placed in the stables and cow-stalls as litter for the cattle. The ground under them is dug to a certain depth, so as to admit a considerable quantity of these peat sods, and fresh ones are added as the feet of the cattle tread them down into less compass. These compose so many beds of manure, thoroughly impregnated with the urine and dung of the cattle. This mixture produces a compost of excellent quality for fertilizing ground where corn is to be sown."

But the most remarkable practice of the Flemish cultivators is the application of liquid manure. Under the farm buildings, large reservoirs are constructed, into which the draining of the dung, the urine of the cattle, and the contents of the privies, all run. This receptacle is divided by rails, so as to prevent any more solid substances from coming into that part where the pump is placed, by which it is raised from the reservoir into the carts employed to convey it to the fields. The liquid in these receptacles is commonly increased in efficacy by throwing into them, for solution, large quantities of rape-cake. This liquid manure, enriched by oil-cake in proportion to the purse or the spirit of the proprietor, is spread over the land, sometimes by the hand; and by habit the workmen have acquired the tact of distributing it equally and in previously prescribed proportions over a whole field. But it is more commonly conveyed to the fields in large casks on wheels, to the bung-hole of which is appended a wooden shoot, narrow at the top, and broad at the lower extremity, which spreads the substance equally. For the flax and rape crops this manure is most liberally used. The quantity of this liquid applied to an acre of flax is commonly about 2500 gallons of English beer measure, in which about 1000 rape-cakes of three pounds each have been dissolved.

No country in Europe provides from its soil so great a quantity of sustenance for its inhabitants, so large a surplus of food for exportation, and such valuable commodities to exchange for articles of foreign growth, as Flanders. Besides wheat, rye, barley, oats, pease, beans, and buck-wheat, madder, rape-seed, hops, tobacco, clover-seed, mustard-seed, flax, hemp, poppy-oil, and some other productions, are raised beneficially, both for home consumption and for exportation. As the inhabitants are in every thing averse to innovation or improvement, the implements of husbandry are in a rude state, and very little variation is made from the examples set by their ancestors some centuries ago. The various machines used in England for abridging animal labour in husbandry are unknown, and the use of human beings is still retained in many operations, for which horses and machinery are adopted by us with great advantage. The same aversion to innovate is seen in the management of the cows, the sheep, and the pigs; the races not having been improved by crossing, as in some other countries. The horses seem to have attracted more attention, and the race commonly seen is excellent for agricultural purposes, as well as for the road.

The separation of Belgium from Holland must have had some effect upon the agriculture of the former country, by excluding for the present the farmers from one of their best markets for corn; but the influence does not appear on the face of the country, where improvements still seem in progress.

In the most remote periods, the Netherlands were distinguished by their manufacturing skill and industry. Under the Romans, the inhabitants of Arras and several other Flemish cities were celebrated for the production of woollen cloths. At a later period, under the Emperor Charlemagne, a present of fine linen and of woollen cloth, sent to the caliph of Bagdad, Haroun al Raschid, was deemed to display the most curious specimens of the industry and skill of the western world. In the instructions of that monarch (*Capitular. de Villis Regum Francorum*), it appears that there existed at Liège, and other cities of the Netherlands, very extensive manufactories, both from flax and wool, in the dyeing of which madder and kermes berries were used, and were forbidden to be adulterated. The ancient condition of the manufactories of the Netherlands is peculiarly interesting, because it is to them that we and the rest of Europe are indebted for the first rudiments of those arts which have since been so widely extended in England, Scotland, France, Germany, and Holland. In the time of Charlemagne, it appears from the same collection, and from the *Historia Monasterii Salmuriensis*, that iron wares, gold and silver work, embroidery, arms, horse furniture, and various other articles, were extensively manufactured. The earliest Flemish fabrics were those of linen; and, as early as the year 960, free marts were established in several of the cities, to which great numbers of merchants from foreign countries periodically resorted. The present state of the linen manufactory is by no means flourishing; but large quantities of the finer kinds, made from flax of their native growth, are supplied by the inhabitants of this kingdom, and are everywhere highly esteemed. The finest yarn and the best bleacheries are at Haarlem; the best linen is woven at Herzogenbasch, Eindoven, and some other places; but some fine linen, spun in Westphalia, is mixed with that of those places, and when bleached in Holland is not distinguishable from it. The curious manufactory of thread lace originated in this country, and still distinguishes it. The best is that of Brussels and Mechlin. In the former city and its vicinity it once gave employment to more than 14,000 persons; and at one period the exports of goods fabricated in Flanders, from the flax of their own growth, amounted to more than L.2,000,000 sterling. The woollen manufactories of Flanders were in a flourishing state as early as the year 980, but were most extensive from the twelfth to the sixteenth century. In the city of Louvain, in the year 1317, there were four thousand looms for weaving woollens. Brussels and Antwerp employed an equal number. Ghent was, however, the most distinguished city for its fabrics, both of wool and flax, and at that period employed 40,000 looms. When called upon to take arms, the weavers, under the banners of their trade, mustered 16,000 men. Ypres contained 4000 looms. Bruges was the storehouse and central point for the commerce of the half of Europe; but in 1478 the situation was changed for that of Antwerp, which continued to be one of the most flourishing cities of the world till the beginning of the sixteenth century, when the tyranny and fanaticism of Philip II. of Spain inflicted on the Flemish provinces the greatest sufferings.

A variety of circumstances have operated upon the manufacturing branches of industry in Belgium, and rendered them exceedingly fluctuating. The great extent of the cotton fabrics has diminished the consumption of linen goods, and been extensively felt in Belgium. In consequence of this, much capital was invested in machinery for making cotton goods, especially at Ghent; and the access to the settlements of Holland in the East and West Indies gave a degree of energy to the employment which the separation of the two countries has damped, if not quite destroyed. The home consumption, however, is very great, owing to the density of the population, and the general state of easy, if not affluent circumstances, in which the great economy of the people places them. In Ghent, Brussels, and some other spots, cotton goods are made. Verviers and the towns near it are celebrated for their excellent cloth; and in all the towns and villages, the making of linen and lace is a kind of domestic employment. There are refineries for sugar in Antwerp, Ostend, and Brussels. The produce of the mines of coal and iron in the provinces of Liège, Namur, Hainault, and Luxembourg, have laid the foundation of hardware manufactories to a great extent in the city of Liège, and on the banks of the Meuse. The chief evil which has been produced by the separation from Holland is experienced in the mining provinces. In consequence of this event, the whole of Holland now obtains its supply of the important article of coal from England, and of iron from our country, or from Russia and Sweden.

Belgium is well situated for foreign trade. The whole of its coasts are indeed rendered dangerous from sand-banks; but the channels between them and the shore are well buoyed and lighted, and there is a vast number of excellent pilots at all the various stations. The three ports are Ostend, Nieuport, and Antwerp. The first two are tide-harbours, but the latter is situated upon the Scheldt, and is accessible to the largest class of vessels in any state of the tide. It has also the advantage of capacious docks and storehouses, and is thereby admirably adapted to become a depôt for an extensive commerce with the south of Germany, and with Switzerland. As the Dutch possess the shore on both sides of the entrance of the Scheldt, this has proved a discouragement to the trade of Antwerp, though a temporary agreement has been made; and some impediments have been thrown in the way of the intercourse between Belgium and Germany by the financial confederation formed by Prussia. From these circumstances, some of the most considerable houses who were ship-owners have removed their establishments, including their vessels, from Antwerp, to Rotterdam and others of the ports of Holland. The Belgians have, however, been actively awake to the events of the period, and are making efforts to open new and favourable communications between Antwerp and the Rhine. A projected line of railroad has been completed as far as Brussels, a distance of thirty miles, and will be continued till it reaches the Rhine. These roads, in addition to the numerous canals and rivers which facilitate internal intercourse, are considered as likely to be productive of great commercial advantages.

The religious establishment of Belgium is strictly that of the Roman Catholic church; but its endowments are much curtailed by the long subjection to France. The whole of the inhabitants adhere to that communion, with the exception of 12,500 Protestants, mostly foreigners, and 1050 Jews. These are allowed to celebrate publicly their several modes of worship. There are two universities, one at Liège with about 500 students, and another at Ghent with about 400; and several seminaries for clerical education. The system of popular education is in a state of revision; but the schools will probably be placed under the exclusive superintendence of the clergy, as the classical schools have already been.

The circumstances in which the kingdom is still placed as regards the disputes respecting Luxembourg seem to render a large army necessary. At present the forces on foot consist of 59,000 troops of the line, and a reserve of 58,000; but reductions are in contemplation.

The sole executive government is vested in the king, and the ministers are responsible. The legislative power is lodged in two houses; the senate consisting at present of forty-two members, and the chamber of representatives consisting of eighty-five, no legislators being as yet sent from Limburg or Luxembourg, on account of the uncertainty which exists as to their ultimate fate.

Until the adjustment respecting the debt between Belgium and Holland is completed, it is not easy to state the exact condition of the financial affairs. The revenue is on the increase, but not quite adequate to the expenses of each year. The national debt, when compared with the aggregate wealth of the country, is much lighter than in any other state in Europe; and, with the economy that has been adopted in every branch, a solid peace must in a short period produce general prosperity. (G.)

NETOPION, a name given by the ancients to a very fragrant and costly ointment, consisting of a great number of the finest spicy ingredients. Hippocrates, in his treatise on the Diseases of Women, frequently prescribes the netopion in diseases of the uterus; and in other places he speaks of its being poured into the ear as a remedy for deafness. The word *netopion* is also sometimes used to express the *unguentum Egyptiacum*, and sometimes simply oil of almonds.

NETRAVUTTY, a river of the south of India, in South Canara, which has its source in the western range of the Ghauts, whence its flows in a westerly direction, runs into the lake of Mangalore, and then discharges itself in the sea. It passes by the towns of Arcola and Buntwalla. It is navigable for small vessels as far as the tide flows, which is to Arcola, and afterwards by smaller boats twenty or thirty miles inland.

NETTINGS, in a ship, a sort of grates made of small ropes seized together with rope yarn or twine, and fixed upon the quarters and in the tops. They are sometimes stretched upon the ledges from the waist-trees to the roof-trees, from the top of the forecastle to the poop, and sometimes are laid in the waist of a ship to serve instead of gratings.

NEU-BRANDENBURG, a city of the duchy of Mecklenburg-Strelitz, situated on a small river which empties itself into the lake of Tollen. It is surrounded with walls, and contains 652 houses, with 5145 inhabitants, who are chiefly employed in small manufactories.

NEUDORF, a city of the circle of Zips, in the province of the Hither Theiss in Hungary, situated on the river Hernath. It contains one Lutheran and two Catholic churches, 900 houses, and 5250 inhabitants, who are occupied in making linen goods, and in producing iron and copper wares. Long. 20. 29. 25. E. Lat. 48. 56. 30. N.

NEUFCHATEAU, an arrondissement of the grand duchy of Luxembourg, in Germany, comprehending ten cantons, inhabited by 91,750 persons. The capital is the town of the same name, situated in a raw and cold region of the Ardennes. It contains 230 houses, and 1340 inhabitants, who trade chiefly in cattle.

NEUFCHATEAU, an arrondissement in the department of the Vosges, in France. It extends over 454 square miles, is divided into five cantons and 133 communes, and contains 60,500 inhabitants. The chief town is of the same name, and is situated at the junction of the river Mouzon with the Meuse. In 1837 the number of inhabitants was 3524. Long. 2. 35. E. Lat. 48. 20. N.

NEUFCHATEL, an arrondissement of the department of the Lower Seine, in France, extending over 641 square miles, and peopled with 84,000 inhabitants. It is divided into eight cantons and 200 communes. The capital is the city of that name, situated in a fertile country watered by the river Bethune. In 1837 it contained 3430 inhabitants, who were employed chiefly in making woollen cloths of various descriptions for the Paris market. In the neighbourhood some good cider and perry are made. Long. 1. 30. E. Lat. 49. 45. N.

NEUFCHATEL, or, in German, *Neuenburg*, a canton in the western part of Switzerland. It extends in north latitude from 46. 51. to 47. 10., and in east longitude from 6. 22. to 7. 1., being 293 square miles. It contains three cities, three market-towns, 112 villages and hamlets, with 7468 houses, and 62,500 inhabitants, all of whom are of the Burgundian race, and speak the French language. About 2500 profess the Catholic religion, and the remainder adhere to the reformed church. The land rises like an amphitheatre from the lake of Neufchatel, which is 1312 feet above the level of the sea, to the mountains of the Jura, which divide it from France, the highest points of which are about 3600 feet. The lake of the same name is a very fine object, being about twenty miles in length and four in breadth, and it has the extraordinary depth of 420 feet. The soil is of a medium fertility, generally resting upon a calcareous subsoil, on which the products ripen early. It scarcely produces corn sufficient for the consumption of the people, but it yields abundance of potatoes, pulse, culinary vegetables, and fruits, especially grapes. The wine is of a moderate quality. The quantity usually made is about 600,000 gallons, of which one half is exported. The chief manufacturing occupation consists in making watches and watch movements. About 130,000 are annually sent to other countries; and materials for the interior works, especially the chains, are exported to a large amount. The females are employed in making thread lace. A few good printed calicoes are also produced. The king of Prussia is the prince, and there is a council which regulates the internal affairs, of which the members are chosen for life. The revenue of the principality is 440,000 francs, the expenditure 420,000. It is bound to furnish to the Swiss confederacy a force of 960 men, and a contribution of 19,200 francs. The capital is the city of the same name, situated on the lake, at the point where the river Seyon falls into it. It contains two churches, a senate-house, three hospitals, and 540 houses, with 4715 inhabitants. The chief trade is in wine, and in the craft which navigate the lake, and are partly employed in fishing. Long. 6. 45. 19. E. Lat. 46. 59. 16. N.

NEUGRADISKA, a town of Hungary, in the Sclavonian military frontier province, the capital of the circle of Gradiska, which extends over 668 square miles, and has a population of 59,124 persons, from whom the regiment of its name is supplied with recruits. The town is fortified, and contains a Catholic and a Greek church, with 209 houses and 1349 inhabitants. Long. 27. 19. 27. E. Lat. 45. 27. N.

NEUSATZ, a city of the circle of Bars Varmeyge, in the province of the Lower Danube, in Hungary. It stands on the banks of the Danube, is the seat of a Greek bishop, and has one Catholic and five Greek churches, 2367 houses, and 13,395 inhabitants, who are chiefly Servians and Armenians. It is a place of considerable trade, especially with the Turkish dominions. Long. 19. 46. 51. E. Lat. 45. 16. N.

NEUSOL, a city in the circle of Soler, in the province of the Lower Danube, in Hungary. It is situated on the river Gran, and is the place of assembly of the states of the comitat, and of the several boards of the government. It contains Catholic and Lutheran churches, a castle, 800 houses, and 10,069 inhabitants. There are also seminaries for the education of Catholics and Protestants; and the trade in iron and copper articles is considerable. Near to it good wine is produced, and there is an extensive royal manufactory of warlike arms. Long. 19. 4. 25. E. Lat. 48. 45. N.

NEUSS, a city, the capital of a circle of the same name, in the Prussian government of Dusseldorf. It stands upon the river Erft, which is navigable to the Rhine. It contains four churches, 850 houses, and 7200 inhabitants, who are occupied in manufactures of woollen, cotton, and other articles, and carry on considerable traffic by the Rhine with Holland and the interior of Germany. Long. 3. 30. 55. E. Lat. 51. 18. 2. N.

NEUSTADT, a city of the government of Opplen, in the Prussian province of Silesia, and the capital of a circle of the same name. It stands on the river Braune, sometimes called the Prudnick, and is surrounded with walls. It contains one Lutheran and two Catholic churches, a convent of the order of mercy, 446 houses, and 4520 inhabitants, who produce much linen and woollen cloth, and some cotton goods. Long. 27. 29. 25. E. Lat. 50. 15. 30. N.

NEUSTADT, a city of Bavaria, in the circle of the Upper Danube, and the capital of the bailiwick of the same name. It stands on the Danube, over which there are two bridges. There is an ancient castle, in the great hall of which many venerable curiosities are exhibited. It contains 600 houses, with 4384 inhabitants. It has but little trade, and depends chiefly on the seminaries for education, and the numerous pilgrims who resort to a celebrated image in the church of St Peter. Long. 11. 6. 4. E. Lat. 28. 44. 23. N.

NEUSTADTL, a circle of the Austrian Illyrian government of Laybach, extending over 1530 square miles, containing thirteen cities and towns, and 1835 villages and hamlets, with 29,236 houses, and 160,890 inhabitants, who are, for the most part, of the Wenden or Vandal race, and retain that language, which is a dialect of the Sclavonian. The capital is a city of the same name, situated on the river Gurk; it is fortified, and contains 280 houses, with 2050 inhabitants. Near to it are some warm baths, which are resorted to by invalids.

NEUTER, in *Grammar*, is a term applied to those nouns which are neither masculine nor feminine. The Latins have three genders; the masculine, the feminine, and the neuter. In the modern tongues, however, there is no such thing as a neuter noun.

Verbs Neuter, by some grammarians called *intransitive verbs*, are those which govern nothing, and are neither active nor passive. When the predication expressed by the verb has no object, and the verb alone supplies the whole idea, then the verb is said to be *neuter*; as, I sleep, thou yawnest, he sneezes, we walk, ye run, they stand still. Some grammarians divide verbs neuter into those which do not signify any action, but a quality, as *albet*, it is white; or a situation, as *sedet*, he sits; or some relation to place, as *adest*, he is present; or some other state or attribute, as *regnat*, he rules; and those which do signify actions, but such only as do not pass into any subject different from the actor, as, to dine, to sup, to play, and the like. But this latter kind sometimes cease to be neuter, and become active, especially in Greek and Latin, when a subject is given them; as, *vivere vitam, ambulare viam, pugnare pugnam*. In like manner, the old French poets say, *Soupirer son tourment;* and the English, *to sigh his woes*. This only obtains, however, where something particular is to be expressed, that is not contained in the verb; as, *vivere vitam beatam*, to live a happy life; *pugnare bonam pugnam*, to fight a good fight. However, according to the Abbé de Dangeau, verbs neuter may be divided into active and passive; the former being those which form their tenses in English by the auxiliary verb *to have*, and in French by *avoir;* and the latter, those which form them in English with the verb *to be*, and in French by *être*. Thus, to sleep, to sneeze, *dormir* and *eternuer*, are neuters active; to come, and to arrive, *venir* and *arriver*, are neuters passive.

NEUTERCHENFELD, a town of Austria, in the province of the Lower Ens, where there is an establishment for military invalids. It contains 4950 inhabitants, who are employed in various kinds of trade and manufactures.

NEUTITSCHEIN, a city of the circle Pererau, in the Austrian province of Moravia. It is a well-built town, with two large suburbs, consisting of villages separated from it by the river Titch; but, exclusive of them, the city contains 622 houses and 5410 inhabitants. It is celebrated for the manufacture of fine cloths.

NEUWIED, a city within the Prussian government of Coblentz, on the right bank of the Rhine. It is now the capital of the circle of that name, part of which was a principality, now mediatized, governed by the Prince of Neuwied, comprehending two towns and twenty-seven communes, with 10,960 inhabitants. The place is finely situated, and has a flourishing population, a great part of whom consists of a Moravian establishment, and of several Menonite families. The Moravian house contains between 400 and 500 brethren and sisters, who have an institution for the education of boys, and another for girls, which are attended by considerable numbers from other countries. The whole city has 720 houses, and 4850 inhabitants, who are occupied in various manufactures, and carry on a considerable trade by the river. The prince, author of Travels in Brazil, has a fine palace and museum. Long. 7. 23. 15. E. Lat. 50. 25. 30. N.

NEVA, a river in Russia, flowing through St Petersburg, the capital of that empire. The views upon the banks exhibit the grandest and most lively scenes. The river is in most places broader than the Thames at London. It is deep, rapid, and transparent as crystal, and its banks are lined upon each side with a continued range of handsome buildings. See PETERSBURG.

NEVERS, an arrondissement of the department of the Nièvre, in France, extending over 971 square miles. It is divided into eight cantons and 109 communes. The capital is the city of the same name, situated on the river Loire, where the Never joins that stream. It is beautifully situated on an amphitheatre rising from a bend in the river. The cathedral is a fine ancient building. In 1837 it contained 15,085 inhabitants. There are many china manufactories, several iron furnaces, some glass-houses, and many makers of linen and woollen cloths, of cutlery and common jewellery, and it has a considerable trade by the navigable rivers. Long. 3. 4. 11. E. Lat. 46. 59. 17. N.

NEVIS, or NIEVIS, one of the West India islands, so called by its discoverer Columbus, after a high mountain of the same name in Spain. It is separated from St Kitt's by a strait about two miles broad, and full of shoals, in latitude 17. 14. north, and longitude 63. 3. west. Nevis is a small but beautiful and fertile spot, consisting of one conical mountain about twenty-four miles in circumference, and containing an area of twenty square miles. That this island is of volcanic formation appears evident from a crater being visible on the summit; and the prevalence of sulphur in various parts affords additional proof of the fact. It is beautifully green, perfectly cultivated, and a complete forest of ever-green trees grows like a ruff or collar round the neck of the high land, where cultivation ceases. Its natural fertility is enhanced by an abundant supply of water; and sugar, the staple product, is raised in considerable quantities. Charlestown, the seat of government, lies along the shore of a wide curving bay, and the mountain begins to rise immediately behind it in a long and verdant acclivity. The court-house is a handsome building, with a square in front; it contains a hall on the ground floor for the assembly and the courts of law, and another room up stairs for the council. The island is divided into five parishes, and it has three tolerable roadsteads. In 1831, the population amounted to 500 whites, 2000 free coloured, and 8722 slaves manumitted by the emancipation act; in all, 11,222. The shipping which entered inwards in 1832 amounted to 14,440 tons. The government is quietly and respectably conducted by its council and assembly, but is in certain respects subordinate to that of St Christophers.

The following is a statement of the commerce of this island with the united kingdom. The exports into Great Britain were, in 1834, sugar unrefined, 59,748 cwts., in 1835, 39,637 cwts.; rum, 23,286 gallons in 1834, and in 1835, 39,366 ditto; molasses, 5466 cwts. in 1834, and in 1835, 161 cwts.; arrow-root, 17,768 lbs. in 1835; and during the same year, 1267 lbs. of succades, and 3511 lbs. of cotton.

This island was originally settled by an English colony from St Christophers, and, by the wise management of the first government, it soon became very flourishing. It was taken by the French in 1706, but restored at the peace of Utrecht. In the year 1782 it was again taken by the French, but restored at the peace in 1783.

NEVYN, or NEFIN, a borough-town of the county of Caernarvon and hundred of Dinlaen, in North Wales, 249 miles from London. At this place Edward I. triumphed after his conquest of Wales in 1284. It is a borough, and, conjointly with Caernarvon, Pwllehi, Conway, Bangor, and Cricceth, returns one member to the House of Commons. The population amounted in 1801 to 1028, in 1811 to 1177, in 1821 to 1614, and in 1831 to 1726.

NEW ABBEY, situated near Kilcullen Bridge, in the county of Kildare, and province of Leinster, in Ireland. It was founded by Rowland Eustace, a man of ancient family in that county. The tower is still standing, and also some part of the abbey; the ruins of which have contributed to build several dwellings near it.

NEWARK, a town of the county of Nottingham, in the hundred of its own name, 121 miles from London. It is situated in a rich district, watered by the river Trent, over which there is a bridge, and an access to it by a fine road constructed on arches, so as to escape those inundations to which that part of the river is liable. Newark is a well-built town, with a fine market-place and a magnificent town-hall. The church is considered as one of the finest in the kingdom, and its spire is lofty and elegant. It was erected by King Henry V. A strong castle was built here by King Stephen, the walls of which are still to be traced. The town has withstood several sieges, the last of which occurred in the civil wars of the reign of Charles I., when it was taken after a long defence by the forces of the parliament. Newark was incorporated by Charles II. in gratitude for the defence it had made in his father's cause. It sends two members to parliament. There is a well-supplied market, which is held on Saturday. The population amounted in 1801 to 6730, in 1811 to 7236, in 1821 to 8084, and in 1831 to 9557.

NEWARK, a post-town, and the capital of Essex county, New Jersey, one of the United States of North America. It is finely situated on the west side of Passaic River, six or seven miles by the course of the river above its mouth. It is handsomely built, and contains a court-house, a jail, two banks, an academy, and several places of public worship. The principal manufactures are those of shoes, leather, coaches, fancy chairs, and cabinet work. Morris Canal passes through Newark. In 1820 the population amounted to 6507, and in 1830 to 10,953.

NEWBALD CAPE, a projecting point on the northern coast of New Holland, near the entrance into the Gulf of Carpentaria.

NEW BEDFORD, a town of Massachusetts. See the article MASSACHUSETTS.

NEWBERN, a post-town and port of entry in North Carolina, North America. It is very pleasantly situated on the south-western bank of the Neuse, at the junction of the Trent. It contains a court-house and other public buildings, including several places of public worship. Being considered healthy, as well as eligibly situated for trade, Newbern enjoys considerable commerce, the exports being principally of grain, pork, lumber, and naval stores. A steam-boat plies between this place and Elizabeth city, and thus connects it with the great routes to the northward, and to Charlestown. The population in 1820 amounted to 3363, and in 1830 to 3776.

NEWBOROUGH, or NEWBURGH, a borough-town of North Wales, in the island of Anglesey, and hundred of Menai, 257 miles from London, and twelve from Beaumaris. It was once the residence of the princes of Anglesey, and a corporation founded by Edward I. There is a market, which is held on Tuesday. The population amounted in 1801 to 599, in 1811 to 750, in 1821 to 756, and in 1831 to 804.

NEW BRUNSWICK, a British province of North America, situated between the parallels of 45. 5. and 48. 4. 30. north latitude, and the meridians of 63. 47. 30. and 67. 53. longitude west of Greenwich. It is bounded on the north by the Bay of Chaleurs and the river Ristigouche, which separate it from Lower Canada; on the south by the Bay of Fundy and Chignecto inlet, which nearly insulate Nova Scotia, the latter being divided on the land side by a short boundary line; on the east by the Gulf of St Lawrence and Northumberland Strait, the latter separating it from Prince Edward Island; and on the west by the United States territory, from which it is separated chiefly by the river St Croix. The whole of New Brunswick contains an area of 27,704 square miles, or 17,730,560 acres. The greater part of this vast territory is still in a natural state, covered with dense forests and fine extended prairies, and intersected by numerous rivers and lakes, which afford ample means of inland navigation. Yet, with the exception of a few rocky districts, principally on the coast of the Bay of Fundy, and several not very extensive swampy tracts, the soil of this wilderness is rich and fertile. Its quality here, as elsewhere, may always be determined by the nature of the timber which it produces. Along the countless rivers, there are also innumerable tracts of what is termed here, and in other colonies in this quarter, "intervale land;" and from its being occasionally overflowed, and thus enjoying the advantage of alluvial deposits, it is also termed alluvial soil. In several parts of the interior, generally along small brooks, there are wild meadows, which owe their origin to the dams constructed by the beaver; which, by arresting portions of the streams, have caused the water to flow over the flat tracts of land. The aspect of New Brunswick is bold and undulating, sometimes swelling into mountains, and again subsiding into vales and low lands. Its geology is but imperfectly known. Limestone, graywacke, clay-slate, and sandstone, occasionally interrupted by gneiss, trap, and granite, seem to prevail on the southern coast, the calcareous rock appearing to predominate. Along the shores which face Chaleur Bay and the Gulf of St Lawrence, gray sandstone and clay-slate predominate, with detached rocks of granite, mica, quartz, and ironstone. Specimens of amethyst, carnelian, jasper, and other stones, have been picked up in various places; and marble having fair pretensions to beauty abounds in at least one part of the country. Coal is plentiful in different localities, and iron ore is abundant. The other minerals found are copper, plumbago, and manganese. Salt springs are numerous, and some sulphureous or hepatic springs have lately been discovered.

New Brunswick.

"As we proceed from the sea-coast up the rivers of this province," says Mr M'Gregor, "the rich fertility of the country claims our admiration. A great flat district may be said to prevail, from the parallel of Long Reach, up the river St John, to the foot of Mars Hill. High hills occasionally rise in ridges in various places, but no part of New Brunswick can be considered as mountainous. The scenery of the rivers, lakes, and cataracts is generally picturesque and beautiful, and often wild and grandly romantic." The principal rivers are, the St John, the St Croix, the Petit Condiac, the Ristigouche, the Miramichi, and the Nipisighit, besides which there are innumerable inferior streams. The St John, called by the Indians Looshtook, or the Long River, is, next to the St Lawrence, the finest river in British America. From its source near the Chaudière, in Lower Canada, to where it falls into the Bay of Fundy, it has a course of six hundred miles, for about half of which distance it is navigable. It receives innumerable tributaries, and in some parts presents remarkable natural phenomena, which will afterwards be described, along with the other important streams, when we come to treat of the counties in which they are situated. The wild animals in New Brunswick are, bears, mouse-deer, the cariboo fox, loup-cervier, tiger-cat, racoon, porcupine, marten, beaver, otter, mink, musquash, fisher, hare, weasel, and others. Most of the birds and the fishes common to North America are also plentiful here. The climate may be pronounced very salubrious, and, generally speaking, more healthy than that of England. Consumption and rheumatism are the most prevalent diseases; but agues and intermittent fevers are rare, if not unknown. Sea-fogs frequently envelop the shores of the Bay of Fundy, and render the culture of wheat near the coast uncertain; but they do not appear to occasion any unhealthy tendencies. The temperature of the southern parts is much milder than that of those which border on the Gulf of St Lawrence, the Bay of Chaleur, and Lower Canada. The following is a meteorological return for Frederickton, the capital, situated in latitude 45. 57. and longitude 66. 45: Daily average for January, 17; for April, 40; for August, $69\frac{3}{4}$; for October, $47\frac{1}{2}$; for December, $13\frac{1}{2}$. Mean of the whole, $41\frac{5}{8}$.

New Brunswick is divided into ten counties, viz. Gloucester, Northumberland, Kent, Westmoreland, St John's, Charlotte, King's, Queen's, Sunbury, and York. The three counties first enumerated were originally comprised in one county, named Northumberland; and their characteristics are nearly the same. They have a sea-board along the Gulf of St Lawrence, the shore of which is low and sandy, covered with trees of a stunted growth, and skirted with extensive marshes, large and deep morasses, and long sand beaches, formed by the conflicting currents of the gulf and the various rivers which penetrate the shore. The coast line of the magnificent Bay of Chaleur has much the same character as the gulf shore. At its mouth, contiguous to New Brunswick, are the islands of Shippigan and Miscou. The former is about twenty miles long;

is low and sandy, and produces bent grass, fir and birch trees, shrubs, and a great abundance of cranberries, blueberries, and other wild fruits. The soil is tolerably fertile, and the island is inhabited by Acadian French. Miscou island is about ten miles in circumference; and here the French once had an extensive fishing station, the remains of their buildings still being seen. The great river of the district just described is the Miramichi, which, from its position on the map, appears to be the great drain of the counties of Northumberland and Kent. It falls into the Gulf of St Lawrence in latitude 47. 10. north, and longitude 64. 40. west, forming at its estuary a capacious bay, with several islands, and a ship channel for vessels of seven hundred tons burden, which can navigate for upwards of thirty miles from the sea. The importance attached to Miramichi has arisen within the last twenty-five years, in consequence of the vast quantity of timber exported from it; and this has superseded almost every other pursuit. Upwards of two hundred vessels annually load with timber for Great Britain and other countries. Chatham, the principal seaport town of the district, is situated on the south-eastern bank, about twenty-five miles from the Gulf of St Lawrence; and on the opposite banks are the towns of Douglas and Newcastle. In 1825, this part of the country became the scene of perhaps the most dreadful conflagration recorded in the history of the world. The catastrophe was preceded by a fearful hurricane, which, sweeping through the forest, parched almost to tinder by an unusually hot and long summer, soon wrapped both sides of the river in one tremendous blaze, extending over more than six thousand square miles of country. Several towns, about five hundred human beings, and an inestimable amount of animal life, perished in the flames. Seven miles above Chatham the Miramichi divides into two great branches, and these again are broken into innumerable streams. The sea-coast of this river is low; but inland the country rises in some places, consisting of extensive and rich intervales, and in others, of a rugged, rocky territory. It is as yet but thinly peopled, having scarcely recovered from the desolating effects of the fire in 1825; but the establishment of the New Brunswick Company will no doubt gradually facilitate the settlement of this fine portion of the country.

Gloucester county, commencing about thirty miles north of the Miramichi, stretches along the shore round the island of Miscou, up the south side of the Bay of Chaleur, and onward to the sources of the Ristigouche. This river is about two hundred and twenty miles long, and forms at its estuary a large and commodious harbour. For upwards of two hundred miles from its embouchure it is above a mile in breadth; and from thence to within forty miles of its source, it is navigable for barges and canoes. The scenery upon this river is exceedingly grand and impressive; much of the territory is rich upland, skirted with large tracts of intervale, and covered with a dense and unviolated growth of mixed wood, in which large groves of pine are very conspicuous. There are several other rivers of considerable size, as the Nipisighit and the Upsalquitch; but the county, notwithstanding its many natural advantages, is but thinly sprinkled with inhabitants, except along the shore from Nipisighit to Ristigouche. St Peter's or Bathurst, the county town, situated on the eastern side of Nipisighit, is a flourishing little settlement, provided with a commodious haven, where, for several years past, timber of most excellent quality has been shipped. Kent and Westmoreland counties present nothing that requires particular mention. They have both an extensive sea-board, several large rivers, and tracts of excellent soil. Two thirds of Westmoreland has a water frontier; and, forming, as it does, the only land communication between Nova Scotia and New Brunswick, it is a rich and valuable district.

St John's county is bounded on the south and south-east by the Bay of Fundy, on the north and north-west by the King's county, on the east by Westmoreland, and on the west by Charlotte county. The corporate town, or city of St John, is situated on the southern declivity of a peninsula, and on the northern side of the entrance from the Bay of Fundy to the river St John, in latitude 45. 20. north, and longitude 66. 3. west. It is not the metropolis, although the largest town in the province, and the emporium of the greater part of its inland trade. St John's is a handsome place, but situated on rocky and irregular ground. The government and public buildings, which are numerous and built of stone, if not splendid, are handsome structures. Being an incorporated city, St John's is governed by a mayor, aldermen, and commonalty, who have an annual revenue at their disposal for the improvement of the city, which has a population of about 12,000 inhabitants. There is here a good and thriving bank, places of worship for various persuasions of Christians, some literary institutions and schools, and the society of the place has latterly much improved. The harbour is easy of entrance, capacious, and safe, with a lighthouse on a small island about the centre of the entrance. On the opposite side of the river, and under its municipal government, stands a pretty little town called Carleton. The upper part of St John's is named Portland, and the whole, including Carleton, is divided into six wards. There are always troops stationed here; and the barracks are spacious, handsome, and commodious. The country in the vicinity is stubborn, but, when subjected to cultivation, it is fertile. An extensive prairie of about 3000 acres, and occupying a space which is by some considered as the ancient bed of the river, lies near the town. The soil is remarkably rich and productive. About a mile above the city, the river St John passes through a fissure of solid and overhanging rock, exhibiting every appearance of having been formed by a convulsion of nature. Through this narrow passage of only 1300 feet the immense volume of water collected during a course of many hundred miles is compelled to pass, and occasions what are called the falls of St John, which foam and thunder through with tremendous violence. Navigation is thus rendered impracticable, except for four short diurnal periods. But the tide rises to a great height at St John's, and when the flood rises twelve feet at the fort, sloops and schooners pass in safety for about twenty minutes, and during the same space of time when the tide ebbs to twelve feet. Above the falls the river widens, and forms a bay of some magnitude, surrounded by high and rugged woodland. Passing up the bay, the country assumes a very grand aspect, high calcareous rocks and vast pine forests stretching up the sides of lofty hills and promontories. Still farther up is Grand Bay, where the same scenery prevails. From this extensive bay Kennebekacis Bay and River trend away to the eastward for nearly forty miles, twenty of which are navigable for large vessels. By another curve of the river a beautiful vista, of eighteen miles in length, called the Long Reach, is formed; and still farther up is Belle Isle Bay, a fine sheet of water, which here branches off for upwards of twenty miles to the westward. The St John then winds to the northward towards Frederickton, receiving the waters of the Washdemoak and Grand Lake from the east, and the Oromucto from the west. No part of America exhibits greater beauty or more luxuriant fertility than the lands upon each side, and the islands here situated. A great proportion of the soil is intervale or alluvial, and coal is found in great plenty, so that it must ultimately become a very rich and populous country. Beyond Fredericktton the river St John winds through a fertile and wooded country, and receives several large rivers in its course. One hundred miles distant from Fredericton is Mars Hill, interesting from the circumstance of its being the point fixed on by the British commissioners as the commencement of the range of high lands forming the boundary of the United States. The mountain is about three miles in length, with a base of upwards of four miles, and an elevation of 2000 feet above the level of the sea. The prospect from the summit is extensive and grand, embracing an undulating expanse of forest, varying in shade from the funereal green of the fir to the bright verdure of the birch. The next objects of any interest, as we proceed to the source of the St John, are the grand falls, where, for a mile, the river foams and boils through contracting walls of rock and over perpendicular precipices. Farther up there is a straggling colony of Acadian French at Madawaska, some miles above which the St John receives the waters of the Madawaska, which issue from the Lake Tamisquata, a sheet of water about thirty miles in length by two or three miles in width. It is only necessary to state with respect to this rich and fertile part of the country, that it is claimed by the Americans, who do not appear to have the shadow of a right to it.

York county, which is traversed by the river St John, is bounded on the north by the river Ristigouche, on the south by Charlotte county, on the east by that of Sunbury, and on the west by the United States. It is of great extent, but thinly settled, and in several parts little known. It is well watered by various rivers and lakes; and although the soil is in some places rocky, there is a large quantity of intervale or alluvial land, which, at the settlement of Madawaska and some other parts, is well cultivated. This county contains Frederickton, the metropolis of New Brunswick. This town is regularly laid out on the right bank of the river St John, which here forms an angle, enclosing the city on two sides; whilst on the land side, in front of it, stretches a chain of hills. The streets are disposed rectangularly, some of them being a mile in length, and for the most part composed of wooden houses. The public buildings consist of the province hall, where the provincial assembly and courts of justice congregate, the court-house, barracks, government-house, library, several churches, and other structures. The trade of Frederickton consists principally in selling British goods to the settlers along the river St John and its streams, and receiving timber and agricultural produce in return. Its situation as a central dépôt for commerce and military purposes is admirable, and it will doubtless increase rapidly with the advancing prosperity of the province. The population may be estimated at about 500.

The remaining counties of New Brunswick present little requiring special notice. Sunbury county contains some of the most productive tracts in the province, from being annually overflowed by the St John. These parts of the country exhibit a most luxuriant scene during harvest. Sunbury is computed to contain 40,000 acres of pasturage and tillage ground, and upwards of 20,000 of meadow ground. Contiguous to it, but lying on both sides of the river, is Queen's county, which is extensively fertile, and yields fine timber, in large quantities, for ship-building. The same remarks apply to King's county, which embraces the whole of Belle Isle Bay, the Long Reach of St John, and the estuary of the Kennebekacis, including Long Island and Kennebekacis. Charlotte county, opposite to St John's, on the other side of the river, contains the well-laid-out town of St Andrews, which has about 5000 inhabitants. This district abounds with spacious, excellent, and easily accessible harbours. Connected with it are the islands of Campo Bello, Grand Manau, and Deer Island. Campo Bello, about eight miles in length by two in breadth, is in a high state of cultivation. Grand Manau, near the entrance of the Bay of Fundy, is twenty miles in length by about five in average breadth. A great part of it is cultivated; the herring fishery is extensively prosecuted on its shores; and from its situation, commanding the entrance to the Bay of Fundy, it is valuable as a defensive position. Deer Island, lying at the entrance of Passamaquoddy Bay, is studded with numerous islets, some of which are richly wooded. This noble bay has the advantage of being free from ice to a greater extent inland than any other harbour north of New York.

Agriculture is yet in its infancy, and can scarcely be said to have existed till 1825, about which period agricultural and emigrant societies were formed; and since then a desire to bring the soil under culture has been gradually diffusing itself over the province. In the interior all kinds of grain and vegetables arrive at full perfection, and on alluvial lands yield great returns. Heretofore it has been necessary to import grain and flour for home consumption; but this cannot long continue in a country where the necessaries of life may be so readily procured. Of agricultural stock, the number of horses is estimated at 12,000, that of horned cattle at 87,000, hogs 65,000, sheep 105,000, whilst the number of acres of land under cultivation is about half a million. The staples of the province are timber and fish. The felled trees are cut up into square timber, deals, spars, and staves, for which purpose an immense number of saw-mills are required. In 1833 the number of establishments for sawing deals in New Brunswick was 228, the estimated quantity of lumber sawed at which during the same year amounted to 103,840,000 feet. The amount of shipping employed in the timber trade is necessarily very great; and for this reason the province assumes an importance which it does not seem to possess, considering the number of its inhabitants. In the year 1834 there entered inwards from Great Britain, the colonies, and foreign states, 3102 vessels, of 304,929 tons burden. In the same year there went outwards 2605 vessels, of 316,214 tons burden. A considerable whale fishery has commenced, and several large vessels proceed from New Brunswick to the Pacific and Eastern Oceans for seals, sperm, and black whale oil. In 1833 there were employed in the coasting trade 550 vessels of 34,780 tons burden. During the same year there were fishing for bounty thirty-five vessels of 1615 tons burden, and not for bounty twenty-eight vessels of 1048 tons burden. For the year ending January 1833, the total imports amounted to L.590,488, and the total exports to L.411,572. The trade of this province consists chiefly in exporting square timber, deals, spars, staves, and a few firs, to Great Britain and Ireland, in return for British manufactures; and also in shipping boards, shingles, scantling, and fish to the West Indies, for which rum, sugar, tobacco, and dollars, are brought back. Gypsum and grindstones are shipped on board of American vessels, and flour, meal, bread, and even Indian corn, are received in exchange; a trade which reflects little credit on the industry and enterprise of the New Brunswickers, who possess so much valuable soil capable of producing all kinds of grain.

The constitution of this province is similar to that of the other North American colonies, except that the lieutenant-governor's executive council of twelve have also a legislative capacity, which is not the case in the Canadas. The house of assembly consists of twenty-eight members, sent by the different counties. The provincial parliament sits for about two months during the winter at Frederickton. The laws are administered by a supreme court and minor tribunals. The former has a chief justice and three puisne judges. There are also courts of chancery, vice-admiralty, and for granting probates of wills, and for other purposes. The revenue of New Brunswick is chiefly derived from duties levied on the importation of goods at the several ports of the province. The grand total revenue of the province in 1832 was L.68,769. The expenditure was about the half of that sum, the surplus being laid out

Newburgh.

in the construction of roads and bridges, in which the province was greatly deficient, and for the purposes of education. Grammar schools, and those on the Madras system, are established in all the settlements; and a college has been built under the auspices of Sir Howard Douglas, to whom the province is otherwise much indebted. The established church is within the diocese of Nova Scotia, to which persuasion there belong twenty-six churches, each having one clergyman, and the whole being superintended by an archdeacon. The Presbyterians, Methodists, Baptists, Roman Catholics, and others, have also places of worship. There are eight newspapers published; and altogether the social aspect of New Brunswick is as promising as that of any of our North American colonies. The improvement of the province will be greatly accelerated by the New Brunswick Land Company, which was established in London in 1832. This company purchased from the crown 500,000 acres of fertile inland territory, at 2s. 6d. per acre, which is in the course of being disposed of by the board of management established in London. The population of New Brunswick in 1824 amounted to 74,176; and it may now (1837) be estimated at 90,000. It appears that the legislative assembly has passed a bill for the support of the civil government of the province, in conformity with the terms prescribed by the head of the colonial department in this country; and that the crown has, in consequence, surrendered to the legislature the casual and territorial revenues of the province. The history of this province is comprehended in that of Nova Scotia, to which article the reader is referred. (R. R. R.)

NEWBURGH, a royal burgh and parish of Scotland, in the county of Fife, advantageously situated on the south side of the river Tay. The town seems to be coeval with the abbey of Lindores, and was early created a burgh of regality under the abbot of that place. In the year 1457 it was erected into a royal burgh, and the charter was again renewed by Charles I. in the year 1631. The royalty extends over 400 acres, of which 178 imperial acres belong to the burgh. The town of Newburgh may be said to have been entirely rebuilt within the last fifty years. It consists of a single street of considerable length, which has been levelled to a gentle slope, the side paths being neatly paved. This street is parallel with the course of the river; and from its centre a by-street leads down to the harbour, which formerly consisted of three continuous piers, projecting into the south deep of the river; but towards the east two additional piers were lately erected, on which have been built several dwelling-houses, storehouses, granaries, and other conveniences for commerce. A new town-house was erected in 1808; and there has recently been attached to it a building of considerable dimensions for the accommodation of those engaged in the stock-market. The new parish church was erected in 1833; it is in the Gothic style, and is a handsome and elegant structure. There is also a meeting-house of the United Associate Synod, which is a plain and commodious edifice. The whole of the buildings are constructed of the greenstone trap found in the parish. The town is lighted with gas. The principal employment of the inhabitants is connected with the linen trade, which is in the hands of thirteen individuals, who not only employ all the weavers in Newburgh, but furnish work for great numbers in the different villages throughout Fife. They also export their goods directly to the West Indies and South America. There is here a considerable trade in corn; and Newburgh divides with Kirkcaldy the exporting of the grain and other agricultural produce from Fife. There are only ten vessels, from sixty to a hundred and fifty tons burden, that belong to Newburgh, and these are chiefly engaged in the coal trade; but vessels from all quarters land and take in their cargoes here. Besides, those bound for Perth must often wait for the flowing of the tide, and many of them have to unload part of their cargoes before proceeding. The river here is about two miles broad, and ships of 500 tons burden can reach this port. Operations have, however, been commenced on an extensive scale to contract the river, as well as to deepen it by dredging. Salmon fishing is carried on to a considerable extent, and affords employment to about sixty of the weavers of the place during the summer months. The fish are shipped for London by one of the Dundee steamers. The principal objects of interest in the parish are the remains of the celebrated abbey of Lindores, which was founded in the year 1178; Mugdrum's Cross, a little to the westward of the town; and Macduff's Cross, about one mile to the south. The value of the raw agricultural produce of the parish is about L.6000 a year; and the sum annually expended in the manufacture of linen in the town amounts to about L.128,500. The debt of the burgh is nearly L.1650. Its yearly revenue is about L.170, and its yearly expenses amount to nearly L.100. The burgh is governed by two magistrates and fifteen councillors. The population of the parish and burgh amounted in 1811 to 2118, in 1821 to 2190, and in 1831 to 2642. The parliamentary burgh voters give their suffrages in the election of a member for the county of Fife.

Newburgh || Newcastle-under-Line.

NEWBURY, a market-town of Berkshire, in the hundred of Faircross, fifty-three miles from London. It is situated in a beautiful valley, through which runs the river Kennet, which being joined by a canal with the Avon, forms a water communication between Bristol and London. The great road to the former city is at the end of this town. It was famous for its woollen trade in the reign of Henry VIII.; and it is related that Jack of Newbury sent one hundred of his clothiers, armed at his own expense, on the expedition which terminated in the battle of Flodden. Several of the public buildings and charitable endowments were founded by the same individual. That trade by which his wealth was gained has disappeared. The town is well built, the streets are wide, and the buildings handsome. The principal trade is that which arises from the transit of goods on the canals and the river Kennet. It was incorporated by Queen Elizabeth, and is governed by a mayor or high steward, and aldermen, but has never sent members to parliament. Near this town two battles were fought during the civil war between Charles I. and the parliament. There is a large market, which is held on Thursday. The population amounted in 1801 to 4275, in 1811 to 4898, in 1821 to 5347, and in 1831 to 5959.

NEWCASTLE, a small market-town of South Wales, in the county of Carmarthen, 216 miles from London. It stands on the river Teifi or Tawy, and is situated in a dreary mountainous district, but has a well-attended market on Monday. The fine castle which stood here is now in ruins.

Newcastle is also the name of a handsome town in the county of Limerick and province of Munster, on the high road to Kerry, 145 miles from Dublin. It consists of a large square, where markets and fairs are held, and possesses a handsome church, Catholic chapel, market-house, and barracks. Here the knights templars formerly had an establishment, the ruins of the walls and fortifications of which still remain. The population at last census amounted to 2866.

Newcastle-under-Line, a town of the county of Stafford, in the hundred of Pirehill, 149 miles from London. It is situated on a small branch of the Trent. It had once four churches; but these, with much of the town, were destroyed in the civil wars. The chief trade of the town consists in making hats; but as coal is abundantly obtained near it, a great quantity of pottery ware is made in the neighbourhood. It is a corporate town, governed by a

Newcastle-upon-Tyne. mayor, two justices, and twenty-four common council men, and returns two members to parliament. It has a good market on Monday. The population amounted in 1801 to 4604, in 1811 to 6175, in 1821 to 7031, and in 1831 to 8192.

Newcastle-upon-Tyne is an extensive and wealthy town in the county of Northumberland, of which it is the metropolis; but it is also a county of itself. As its name denotes, it is situated on the river Tyne, to which circumstance it is principally indebted for its flourishing condition. That river is formed out of two branches, one called the North Tyne, which rises upon the borders of Scotland near Keilder, and, after passing Falstone, Greystead, and Bellingham, receives the water of the river Reed, and near Woodburn is joined by the South Tyne, which rises behind Crossfell, on the borders of Cumberland, and passing Haltwhistle, forms the united stream at Warden near Hexham. The mass of water then passes Newcastle, and empties itself, after a course of near seventy miles, into the German Ocean, between the towns of North and South Shields, which stand on the banks at the mouth of the river. At the extreme point on the northern bank is the town of Tynemouth, with its haven. This latter place is known to seamen in the day by a castle in ruins on the northern side, and in the night by a revolving light, which is constantly kept burning, and exhibits a face every minute.

Within the river, near the town of North Shields, there are two lighthouses for the use of vessels passing over the bar. There are three warping buoys within the river, two on the south and one on the north side; and in addition to these, there is a distinguishing buoy on the north side, where the low light is situated. The tide flows up the Tyne from Shields to a distance of eighteen miles; and at Newcastle Bridge it generally runs upwards about four hours and a half, and downwards about seven hours and a half. The perpendicular rise at the bar, at Tynemouth is about eighteen feet, and at the bridge from eleven to twelve feet. It is high water on the bar, at the full and change of the moon, at about three o'clock if the weather be settled; but a strong northerly wind will sometimes make it high water an hour sooner, and a strong southerly wind an hour later, than the regular course; and there will be at times two or three feet more water on the bar with a strong northerly wind than with a strong southerly one. The corporation are making great exertions to improve the navigation of the river, and employ a powerful steam-engine for the purpose of dredging.

Due precautions against accidents to shipping have been rendered necessary by the vast number of vessels that pass up and down the Tyne; and an association, formed in 1825, at the Trinity House, has for its object the preservation of lives from shipwreck, and the maintenance of a life-boat at South Shields. The pilots on the river are remarkable for their skill and carefulness, and are under the regulation of the corporation of the Trinity House, who have an office on the quay. The bridge was founded in very ancient times, and consisted of wood. It was once burnt, and at subsequent periods was more than once carried away by the floods. The existing bridge was built between the years 1775 and 1799. It was only twenty-one feet wide, which, as the population and trade increased, was found very inconvenient; and in 1801 it was enlarged and widened, and is now thirty-three feet six inches in width. It connects the town of Newcastle with its suburb Gateshead, which is in the county of Durham.

From the bridge a fine quay extends along the river 500 yards in length. The new corporation have commenced a most important improvement, by lengthening the quay one thousand yards eastward, and a still greater extension is intended. When completed, it will make this the finest quay, for commercial purposes, in Europe. The buildings on the quay consist of shops, warehouses, and taverns; the custom-house stands on the quay, and in lanes leading from it there are a number of extensive warehouses belonging to private merchants, and also a large bonding tobacco warehouse under the care of the custom-house.

Newcastle is to be chiefly viewed as a trading town; and as the principal foundation of its trade is the shipping of coals, we shall first take a view of the growth and extent of that branch. It is doubtful when coals were first discovered and applied to serve as fuel; but by some ancient documents it seems to be shown that in the year 1280 the revenue of this town arising from the sale of coal amounted to L.200 per annum. In 1306 it must have been introduced in London, as the parliament complained to the king of its infecting the air with noxious vapours, in consequence of which the use of coal was prohibited, and strict orders given to destroy all furnaces and kilns in which it was used. Coals, however, must have again come into use in 1327, as at the coronation of Edward III. a debt appears to have been due for this mineral; and in the same reign orders were issued relating to the measuring of coals, and such as were got in the field of Gateshead were to be taken across the Tyne in boats, and, after paying the custom-duty, to be sent to any port of the kingdom, but to no port out of the kingdom, except to Calais. About the year 1338 the prior of Tynemouth granted colliery leases. In the year 1582 Queen Elizabeth obtained a lease for ninety-nine years of the manors and royalties of Gateshead and Whickham for L.90 per annum, which caused the price of coals in London to rise to nine shillings the chaldron; upon which the lord mayor made application to Lord Burleigh that the price might be reduced to seven shillings. In 1615 the trade appears to have employed 400 sail of ships, some of which sailed to France, and others to the Netherlands. During the civil wars the trade and the prices of coal fluctuated much, as at one time London was with the parliament and Newcastle with the royal party. In 1675 the shipping of Newcastle was estimated at 80,000 tons. In 1710 the annual average export for the three preceding years had amounted to 178,143 chaldrons, and in 1776 to 260,000. The following account will show the vast but gradual increase since that time.

An Account of the quantity of Coals shipped at Newcastle from 1794 *to* 1836, *distinguishing those sent Coastwise and those over Sea.*

Year.	Coastwise. Chaldrons.	Over Sea. Chaldrons.
1794	388,724	39,935
1800	537,793	47,487
1805	552,827	49,572
1810	632,299	17,258
1815	650,209	42,834
1820	756,513	44,826
1825	687,029	51,444
1826	792,365	62,620
1827	683,745	65,417
1828	725,082	59,325
1829	738,426	61,653
1830	817,870	74,456
1831	772,686	60,848
1832	682,797	74,467
1833	699,741	73,186
1834	761,306	85,828
1835	853,359	116,803
1836	858,403	155,357

The preceding account is given in Newcastle chaldrons, which weigh fifty-three hundred, but the London chaldron

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weighs only twenty-eight hundred. The former contains sixty-eight, the latter thirty-six Winchester bushels. Since the duty on coals water-borne has ceased, the account of the quantities shipped has been kept with less correctness.

It may be observed in this place, that whilst describing the shipping and trade of Newcastle, the transactions of the towns of North and South Shields, and of Tynemouth, are comprehended, as far as regards the official returns, because these returns are taken from the books of the custom-house, which is at Newcastle alone. These towns, which are a portion of the port, contain together nearly 30,000 inhabitants. The larger ships are, in fact, mostly loaded and discharged near them, though vessels of 300 or 400 tons burden may at high water reach the bridge between Newcastle and Gateshead. The whole extent of the port is such that two thousand sail of vessels may lie in a state of security within its limits.

It is very difficult to estimate with accuracy the proportion which the coals raised in the vicinity of Newcastle, and shipped from its port, bears to the whole quantity raised in the kingdom. We must trust to estimates by no means deserving of implicit confidence, when we state that the trade of digging coals, and of conveying them to the ships, gives in this vicinity employment to 75,000 persons; that a capital amounting to L.4,000,000 is invested in it; that the weekly value of that which is sold amounts to L.60,000; and that the duty paid on it in 1831, when it ceased, was about L.600,000.

As Newcastle is a kind of metropolis to a considerable portion of the northern counties of England, it has very extensive commerce in almost every other branch of trade. It has, however, one branch of most extensive value, as connected with our naval defence, that of ship-owning, under which some of our best operative seamen are trained up with a skill, activity, and perseverance that is exceeded by no sailors in the world. The extent of this branch of industry may be seen by the following table.

Vessels registered at the Port of Newcastle.

Years.	Number of Vessels.	Tonnage.	Number of Men and Boys.
1821	822	178,047	8,369
1825	909	193,014	8,752
1830	986	203,587	9,496
1834	1097	219,640	10,173
1835	1076	211,173	9,806
1836	1080	213,907	......

It has been estimated that this town has belonging to it one sixteenth part of the whole tonnage of the British empire. In the year 1836 there were registered in the port of Newcastle ninety-one steam-vessels.

If the amount of duty collected at the custom-house be the proper scale by which to measure the foreign trade at the respective ports of the kingdom, Newcastle stands the fifth on the scale of English towns, and next after London, Liverpool, Bristol, and Hull. In 1836, the annual net amount was L.275,369. 9s. 4d.

In Newcastle and its neighbourhood are carried on various important manufactures, which are chiefly fostered by the abundant supply of coal. Amongst these may be enumerated glass bottles and crown and plate glass, patent shot, and all the preparations of lead, whether for pigments or otherwise. The manufacture of iron is carried on upon the most extensive scale, as is the construction of steam-engines, especially those of a locomotive kind, the reputation of the builders being so high that they manufacture not only for all parts of England where railways are established, but also for the continent of Europe and the United States. Mills for the crushing of linseed, manufactories of copperas, coal pitch, spirits of tar, varnishes, soda, aquafortis, whitening, glue, vinegar, and soap, are numerous and extensive.

Since the year 1816 a most important business has arisen in the neighbourhood of Newcastle, namely, the making of crystals of soda and mineral alkali by the decomposition of common salt. For such a manufacture, as well as those of glass and iron already noticed, the banks of the Tyne are, it is true, most favourably circumstanced; but the history of its establishment is curious, and affords an instance of the way in which important trades sometimes owe their origin to little more than individual energy and enterprise.

In the year 1794, Lord Dundonald, who had previously directed his attention to various chemical manufactures, represented to Mr William Losh of Newcastle, the advantage, as he conceived, of a process of his own for making alkali by the decomposition of certain refuse salts; and accordingly a company was formed, consisting of Messrs John and William Losh, and Messrs Surtees, bankers, under the firm of William Losh and Company, who began the trade of making alkali at Bell's Close, on the Tyne, three miles above Newcastle. The refuse salts procured were sulphate of potash from makers of oil of vitriol, and sulphate of soda from makers of marine acid, both of which were at that time to be obtained in great plenty; and Lord Dundonald's process was to decompose them by saw-dust, forming alkaline sulphurets, which, by lixiviation, evaporation to dryness, and exposure to heat, with more carbonaceous matter, he expected to convert into carbonated alkali. In this, of course, he failed; but it is interesting to observe how nearly his lordship approached to success; for if in the first part of his process a little lime had been used, the decomposition would have been accomplished exactly as it is at present. Lord Dundonald then proposed to decompose muriate of soda by potash, obtaining thus carbonate of soda and muriate of potash, both valuable products; and this mode of obtaining soda from common salt was pursued for some time. At the end of little more than a year from the establishment of the works at Bell's Close, Lord Dundonald, who was not a partner, left the neighbourhood of Newcastle. At this time there was known to exist in a colliery at Walker, three miles below Newcastle, a salt spring of very great strength and copiousness, capable, it was said, of furnishing salt enough to supply the consumption of the whole kingdom; and Lord Dundonald, previously to leaving Bell's Close, made the important suggestion to William Losh and Company, of endeavouring to obtain from government a grant of salt for the purpose of making alkali, duty free, from this spring at Walker. Accordingly the application was made, and the company succeeded, in the year 1796, in obtaining a grant of salt to be made from this salt spring, at a duty of thirty shillings per ton. The present alkali works at Walker were soon afterwards commenced, and the establishment at Bell's Close discontinued. Here alkali-making was carried on from potash as above mentioned, and also for some time from oxide of lead, until, about the year 1799, the price of lead became too high to admit of its continuance. About this period the works at Walker became the property of Mr John Losh of Woodside, Cumberland, and were placed under the entire management of his brother, Mr William Losh, who soon afterwards made many important alterations, and who may justly be considered as the father of soda-making on the Tyne. But it is not suitable in this article to trace very minutely the history of soda-making, and it may be sufficient to say, that at Walker the trade was carried on gradually increasing until the year 1816, when Mr William Losh visited France, and brought from thence the process

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now followed universally, which he immediately put into operation at Walker.

This process, for which we are entirely indebted to our intelligent neighbours the French, consists in making oil of vitriol from sulphur, and with the sulphuric acid decomposing muriate of soda, to obtain dry sulphate of soda, which salt is mixed with certain proportions of chalk and coal in powder, and the whole heated in a proper furnace until a sort of incipient fusion takes place, after which the mass is drawn out and suffered to cool, forming an impure carbonate of soda called ball alkali. This ball alkali being lixiviated, boiled down, heated in a furnace to redness, with or without carbonaceous matter, again dissolved, and crystallized, yields the soda of commerce. From 1816 to 1822 alkali-making was carried on only at Walker; but at the latter date Messrs Cookson and Company commenced the manufacture at South Shields, and were speedily followed by other enterprising individuals at various places on the Tyne.

At present there are nine soda manufactories on the Tyne, at which upwards of 1000 workmen are employed; and the quantity of crystallized soda made per week is upwards of 250 tons, besides at least 100 tons of alkali or soda ash, containing from 25 to 45 per cent. of soda, which is sold in an uncrystallized state to bleachers, soap-makers, and others. To produce this quantity of alkali there is burned into sulphuric acid per week 120 tons of sulphur, and the common salt decomposed weekly amounts to nearly 400 tons. The price of crystallized soda was, in the early days of alkali making, 60s. per cwt.; but it is now sold at one fifth of that sum, or 12s. per cwt.; and as society are only beginning to experience the usefulness of the article for domestic purposes, and the demand is consequently likely to increase, it is probable that this branch of manufacture on the Tyne has not yet reached its fullest extent.

The town is supplied with excellent beer from several breweries, which together make about 30,000 barrels of strong, and about 18,000 barrels of small beer, and use in the fabrication about 19,000 quarters of malt. Paper of various kinds is made, and some of it printed; and there are a great number of coaches and other kinds of carriages built. The spinning of linen and woollen thread employs about 300 persons, but chiefly in the surrounding villages, and the salmon fishery on the Tyne is considerable. From this sketch of the numerous products of industry, the export trade may be seen to be extensive in other articles besides coals, cinders, culm, the preponderating commodities of this important trading town.

The imports are various, but the principal articles are corn, wine, spirits, fruits, sugar, tobacco, tea, coffee, butter, cheese, tallow, hides, oak-bark, rags, flax, hemp, linen yarn, mahogany, deals and other timber, spars, masts, cordage, tar, iron, and what is necessary for the equipment of shipping. This view of exports and imports accounts for the number of vessels which have entered this port in successive years from foreign countries.

The municipal government of Newcastle has from a very remote period been conducted by an incorporated body originating in royal charters, and composed of a mayor, aldermen, and common councilmen, with various subordinate officers. Having been originally a Roman station, it became under the heptarchy a regal villa, one of the residences of the Northumbrian kings, styled by Bede, *Ad murum regia villa illustris.* It afterwards obtained the name of Monkchester; but soon after the Conquest, on the construction of a new fortress, it acquired the name which has been continued to the present time. William II. converted the town into a royal borough, conveyed to the burgesses considerable fee-farm rents, and conferred some privileges which were extended by Henry I. Several additional immunities were granted by successive charters, all of which were, in the reign of Elizabeth, in 1660, condensed and confirmed by what was known then as the great charter; and that, being afterwards slightly changed in the reign of James I., continued till the passing of the existing law in 1835. By that law the town has been divided into seven wards for the purposes of that act, and has now fourteen aldermen, forty-two councillors, a mayor, and sheriff, with justices of the peace nominated by the crown.

The revenue of the corporation is very large, arising from a tonnage on coals, a duty for depositing ballast, actual possession of land and houses, and some other sources, amounting together to L.40,000 per annum. The corporation has the superintendence of the river Tyne, which, with the other necessary expenses, and interest on loans, amounts to nearly the same as the income. Besides the corporation, there are many guilds or companies having chartered privileges, and halls for their assembling. There are the Twelve Mysteries, founded between the years 1215 and 1621; the Fifteen By-trades, founded between 1426 and 1626; and the various companies, eight in number, created at different periods, like the others, between the years 1454 and 1675. These companies choose annually sixty-nine stewards, out of which a body of nine is nominated, who are called the Herbage Committee, whose duty it is to superintend the improvement and enforce the regulations respecting the free commons, upon which the burgesses have the privilege of pasturing two cows each, and a free pasturage is thus afforded to 700 fine cows, and also to watch over the interests of the freemen, and of their respective fraternities. They have a revenue of about L.100, derived from ground and dunghill rents, and from other sources.

Newcastle is a county of itself, and the courts of assize and nisi prius are held twice a year for each division; those for the town at the guildhall at the Exchange, and those for the rest of Northumberland in the county courts at the Castle Garth. They are held at the same time. There are also some inferior courts of justice held, such as the mayor's court, in which only free burgesses or their widows are sued, and in which are tried all cases relating to real or personal actions to any amount arising within the town; the sheriff's court, in which all actions are brought as in the mayor's court, but with this distinction, that they may be instituted against all other persons than free burgesses; the court of conscience to determine all debts or actions not exceeding in amount forty shillings, which extends to all persons residing within the liberties of the town; and the court of guild, the chief business of which now is the admission of persons to their freedom, whether they are entitled to it by birth, or by an apprenticeship during seven years. Besides these, a court of admiralty is occasionally held, the principal duties of which consist in preventing injury from being done to the river or to the salmon fishery. The corporation have lately established a body of police upon the London plan, which has been found very effectual.

The population of Newcastle has advanced in nearly the same proportion as that of the other towns of the kingdom. It appears, by the comparative account of the population of Great Britain in the years 1801, 1811, 1821, and 1831, printed by order of the House of Commons, 19th October 1831, that the number of the inhabitants at those periods amounted in 1801 to 28,366, in 1811 to 27,587, in 1821 to 35,181, and in 1831 to 42,760. But each of these accounts is materially deficient, owing to their exhibiting only the number of inhabitants within the limits of that portion of the town which is within the county of the town of Newcastle, and not giving the numbers of the town of Gateshead, which, though one of the suburbs, is within the county of Durham, nor the population of those parts of the

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parishes of the town which are not within the limits of the county. By the enumeration abstract of the population, ordered by the House of Commons to be printed on the 2d April 1833 (vol. i. p. 472), the population is thus shown :

Parishes.	Males.	Females.	Total.
All-Saints	7887	9176	17,063
St Andrews	4984	6452	11,436
St John	3912	4223	8,135
St Nicholas	2877	3249	6,126
	19,660	23,100	42,760
To this must be added the inhabitants of Gateshead in the county of Durham, which is a suburb only divided by the bridge			15,177
Besides this must be added that portion of the parish of All-Saints which is in the east division of the ward of Castle			5,677
Those portions of St Andrew's parish which are in the east and west divisions of the ward of Castle			2,424
The portion of St John's parish which is in the west division of Castle Ward			5,061
Total number of inhabitants in 1831			71,099

If the past rate of increase has been maintained since that period, the whole population at the present time must exceed 80,000 persons.

The public buildings for religious purposes are numerous. Those of the established church claim the first attention. Of these, the mother church of St Nicholas is probably the oldest, and certainly the most striking. It was founded in the year 1091, by Osmond, bishop of Salisbury, and placed under the jurisdiction of the bishop of Carlisle. The edifice was burned in 1210, and the present structure finished in 1359. The interior of the church is 242 feet, and on entering it by the great western door, the spectator is struck with mingled impressions of delight and solemnity, from the general and noble effect produced by the view. Some considerable improvements in the arrangement of the pews made in 1783 have adapted it for accommodating a congregation of more than 1200 persons. The organ is a remarkably fine instrument. The frame-work is mahogany, and the two pillars in front are magnificent; the centre is surmounted by the figures of two recumbent angels, and the compartments of the front are embellished with a variety of richly gilt pipes. There are several fine specimens of modern sculpture lately erected on this edifice, and these marble monuments have been very costly. A public library is attached to this church, formed by donations at different periods since the year 1661, but principally by Dr Thorburn.

St John's church is an ancient structure, and supposed to have been built in the latter end of the thirteenth century; but it has since been enlarged and beautified at different periods. The great eastern window contains some curious ancient specimens of stained glass. By the erection of some new galleries and other arrangements of pews, it has been made capable of seating, including scholars in the aisles, more than 1400 persons. It has a square steeple with four pinnacles, a clock and six bells, with a large burying-ground adjoining.

St Andrew's church is said to have been built by David king of Scotland, who died in 1153. It still exhibits some specimens of Anglo-Norman architecture, though many alterations have been made at different periods. Being near the town wall, it suffered much during the siege of 1644, and was long afterwards closed. It has lately been furnished with a new organ, and the interior so arranged as to accommodate 1300 hearers, besides 200 children. Near to it is the burying-ground, which, by the destruction of some houses in 1824, is laid open to public view, and handsomely surrounded by palisades.

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All-Saints' church is a modern structure, having been erected between the years 1786 and 1796, at an expense of L.27,000, raised by an assessment upon the owners of houses in the parish. It has a stately Doric portico at the entrance, from which there rises an elegant spire to the height of 202 feet from the ground. It has a fine set of bells and a clock. It contains a spacious gallery, and the whole seat-room will accommodate near 1200 persons, and 270 children of the charity schools, who have seats in the gallery. This building was erected on the site of an ancient church which existed before the year 1284, but which was considerably larger, and capable of containing 2000 persons.

St Ann's church is, properly speaking, a chapel of ease to the parish of All Saints. It was erected in 1768, on the foundation of an ancient building, at the expense of the corporation. It has a large school attached to it, in which boys are instructed in reading, writing, and arithmetic, on very cheap terms. The church has seat-room for about 500 persons.

St Thomas' church is a chapel of ease to the parish of St Nicholas. It was begun in 1828, and finished in 1830. It is an elegant structure, built in the style of one of the earliest examples of ecclesiastical architecture. The church is 135 feet in length and sixty-three feet in breadth, and has a tower 138 feet in height. It can accommodate from 1000 to 1100 persons. In the suburb or town of Gateshead is the church of St Mary, a new steeple to which was built on an old foundation in 1740. Its chief ornament is an elegant window of stained glass in the southern transept, which was presented to it in 1824. There is seat-room for 800 persons, including that for the charity children.

The places of worship for the various classes of dissenters from the established church are numerous. From the vicinity to Scotland, the adherents of the Presbyterian form of worship are the greatest in number, occupying nine meeting-houses, most of them being of the Scotch kirk, and others secessions from it. The next largest portion of worshippers are the Wesleyan Methodists of the new and old connection, who have six chapels, one of them the largest place of worship in the town. The Independents occupy three chapels, the Baptists three, and the following persuasions one each, viz. the Roman Catholics, the Quakers, the Glassites, the Unitarians, and the Swedenborgians.

To the enterprise of Mr Richard Grainger the inhabitants of Newcastle owe the creation of almost a new town, built in a style of architectural beauty not inferior to any in the kingdom. After having built Eldon Square, Blackett Street, and several others of minor importance, Mr Grainger's first exertions in an embellished style of architecture were made on a large piece of ground adjoining the Leazes. Upon this he erected a parallelogram, consisting of upwards of fifty houses, all faced with polished stone, and of great elegance of design, and some of them of large dimensions. This undertaking was carried through by him at the same time that a spacious and splendid arcade was constructed in the centre of the town. The next attempt of this individual was more gigantic, and incurred an expenditure of half a million sterling. There existed in the very centre of the town a large piece of ground, about thirteen acres, which had originally been the gardens of the Grey Friars, and of a convent of Benedictine nuns, but some time ago was the garden of the house of Sir Walter Blackett, Bart., and, latterly, of Major Anderson. This completely cut off the communication between the opposite sides of the town, except by circuitous streets, and was partly occupied by stables, cow-sheds, and other nuisances. Mr Grainger conceived the idea of covering this extensive piece of ground with houses and markets of elegant construction. The purchase of the ground was effected, and the work begun, in the summer of 1834; and its completion will probably not require more than twelve months from the present time (1837). This extraordinary undertaking consists of seven streets, some of them eighty feet broad, and all of stone, and highly embellished; besides a butcher-market and a vegetable-market, which alone occupy a space of more than two acres, and are entirely covered in. These markets are unquestionably the most elegant and commodious in the world. The butcher-market consists of four avenues, nineteen feet four inches wide, twenty-seven feet high, and extending in length 338 feet. The vegetable-market is connected with the butcher-market, and consists of one stupendous hall, 318 feet long, fifty-seven feet wide, and upwards of forty feet high. A new theatre of great architectural beauty, a chapel for the Methodists of the new connection, a new dispensary, and a church, are also included in the plan. The number of houses will exceed 300. Such are the outlines of what has been done, and is in the course of completion. At the top of the principal street, named Grey Street, in honour of Earl Grey, workmen are at present (1837) employed in building a column, which will be 150 feet high, and surmounted by a statue of Earl Grey. This elegant memorial is from a design by Messrs John and Benjamin Green of Newcastle, and the statue is by Bailey of London. The cost is defrayed by public subscription. Within the last ten years there has been erected a large and massive building for the jail and house of correction, which cost L.49,000; and during last session of parliament an act was passed by which twenty new streets are to be made and altered.

Newcastle is quite as well supplied with those institutions which tend to the acquisition and diffusion of knowledge as any other place of its extent in the kingdom. The Literary and Philosophical Society was founded in 1793. Its objects were the discussion of the several branches of polite literature, and making inquiries into the situation and properties of the mineral productions of the neighbourhood, with the elucidation of the sciences applicable to commerce, antiquities, local history, biography, nautical inquiry, and other subjects. A new institution for delivering lectures has been united with it since 1802. A library of more than 12,000 volumes has been collected, and a valuable apparatus purchased for the illustration of chemistry and other branches of physics. The Natural History Society has erected an elegant building, which contains a museum of very great value. The published Transactions of this Society have raised the character of its members to a high rank in that science. In the same building the Newcastle Antiquarian Society hold their meetings.

There is also an establishment recently formed, called the Literary, Scientific, and Mechanical Institution, of which young persons may become members, and attend classes appointed for drawing, mathematics, chemistry, and the languages, at a very small expense. This society is also gradually forming a library, and various collections to assist in science and in art. There are likewise several subscription rooms for newspapers, especially a very good one at the Exchange.

There is a well-endowed royal free grammar school, in which Greek and Latin were intended to be taught gratuitously; but a small fee is now paid by the scholars. It has access to some exhibitions at Lincoln College, Oxford. In several other schools many boys and girls are taught on the Lancasterian and Madras plans, and most of the churches and chapels have schools connected with them.

The institutions for benevolent purposes are numerous, of which the most prominent are Jesus' Hospital, which provides for forty old persons; Blacket and Davison's Hospital, for six poor widows of clergymen or merchants; Westgate Hospital, for aged freemen and widows; the Keelman's Hospital, formed by that class of persons for the relief of their destitute, and chiefly maintained by a duty of one farthing per chaldron on all coals exported from the river Tyne; and the hospitals of St Mary Magdalen and of the Virgin Mary.

The establishments for administering relief to the diseased or infirm poor are, the Infirmary, to which is now annexed a Lock Hospital, and which extends relief to the sick and lame poor of the counties of Newcastle, Durham, and Northumberland, the average annual number of in-patients being 800, and of out-patients 700; the Dispensary, founded in 1777, supported by voluntary contributions, the object being the administration of medical and surgical aid to all diseased applicants, and the promotion of vaccine inoculation; the House of Recovery, for the reception of persons afflicted with febrile diseases; the Lunatic Asylum, for thirty-eight males and the same number of females; the Lying-in-Hospital, for poor pregnant women; the Eye Infirmary; and St Luke's Hospital.

The markets are well supplied with provisions of all kinds, which are sold at very cheap rates; and the market for corn is one of the largest in the north of England. Water is abundantly supplied by the Water Company, from resources and reservoirs in Gateshead. There are no less than twelve public fountains, here called *pants*, in different parts of the town. These are ready to furnish water for the fire-engines, which are under good regulation. There are companies for insurance against fire, as well as for ship and life risks. The town is well watched, and lighted for the most part with gas.

The places of amusement are not numerous; the most prominent being the theatre denominated royal. The former house was opened in 1788, and was pulled down in 1836 to make way for the building of Grey Street. The new theatre, which is a structure of great beauty, was opened in February 1837. The assembly-rooms, built in 1766, are commodiously planned, having a ball-room ninety-four feet by thirty-six, with a music gallery; adjoining are card-rooms, a room for private assemblies, and on the lower story is a supper-room, in which 460 individuals have been accommodated at the same time. There is a music-hall appropriately fitted up, with the requisite auxiliary apartments. The Northern Academy of Arts is solely appropriated for the public exhibition of pictures, and for the purposes of a diorama. The first exhibition of paintings in Newcastle was opened in September 1822.

The communication between Newcastle and the western coast will be greatly facilitated by the Newcastle and Carlisle Railroad, which it is expected will be completed in 1838, and, with the Brandling Junction Railroad, will connect the towns of South Shields, Monk-Wearmouth, Bishop-Wearmouth, and Sunderland, and increase the trade very considerably. The Newcastle and Carlisle Railroad, in its present unfinished state (thirteen miles in the centre not being completed), yields a revenue of L.50,000 a year; and, when completed, it is estimated to produce an annual income of L.100,000. The length of this railway, including the Brandling Junction, will be sixty-five miles from sea to sea.

NEWEL, a circle of the Russian province Witepsk, extending in north latitude from 55. 45. to 56. 20., and in east longitude from 28. 54. to 30. 21. It contains four towns, and 1872 hamlets or farms, in eighteen Greek and twelve united parishes, having a population of 69,430 inhabitants. The capital is a town of the same name, 388 miles from St Petersburg, on the lake Newelskoi, at the mouth of the river Emerka. It contains three churches, 434 houses, and 2860 inhabitants. Long. 29. 30. E. Lat. 55. 58. N.

New England.

NEW ENGLAND, the name of the northern states of the North American union, namely, Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, and Connecticut. The physical characteristics, and the social and commercial relations, of these states, will be found described each under its individual head. But the history of the several states has not yet been given, because, since an account of one state involves to a considerable extent that of another, it was considered as most judicious to give a narration of the whole transactions which have taken place in this part of the American union under one head. In 1606, the portion of North America lying between the thirty-fourth and forty-fifth degrees of latitude was divided into two parts, called North and South Virginia, and granted to two companies. The London Company were allowed to make settlements anywhere between 34° and 41°, and the Plymouth Company received the same privilege in regard to the country between 38° and 45°. Previously to the survey of the coasts by Captain Smith, in 1614, the country went by the name of North Virginia; but in 1660 Prince Charles changed it to that which it now bears, at the same time granting a patent to the Plymouth Company, comprehending that part of the country which lies between 40° and 48° from north to south, and extending throughout the mainland from sea to sea. The name of New England has, ever since the landing of the first settlers at Plymouth, Massachusetts, in December 1620, continued to designate the country lying east of New York; and although it has never, properly speaking, formed a political whole, it possessed from the first, and still possesses, certain characteristics which distinguish it from the rest of the Union. Most of the colonies planted in New England were founded on the same principles of government, by men closely associated with each other from similarity of political and religious views. Before landing, they signed a solemn covenant, forming themselves into a body politic for the purpose of making laws for the general good. The governments which were erected in these colonies were chartered governments, the ownership and administration of affairs being vested in the colonists, whilst the governments of the other colonies were royal or proprietary, civil authority and property being vested, the one in the crown, and the other in the colonists. The New England settlers were republicans before their arrival in North America, and being afterwards joined by those who fled thither as to a city of refuge during the civil commotions in the mother country, and also after the Restoration, the body became very numerous, and they may be said to have adhered to their principles ever since. The early and general provision for common education in New England was another peculiarity of that part of the country. Laws were soon passed commanding the establishment of schools in every town, and these enactments laid the foundation of the New England system of free schools. The organization of the church government is entirely democratical, and the municipal system is in many respects peculiar.

In consequence of the representations made by Martin Pring, an English navigator, who explored part of the shore of New England in 1603 and 1606, a settlement was attempted to be formed at the mouth of the Kennebec, in the state of Maine. But accidental circumstances frustrated this design, and it was not until 1622, when Sir Ferdinando Georges, conjointly with one Mason, obtained a grant of the territory lying between the rivers Merrimac and Kennebec, that such measures were taken as secured a permanent settlement in this part of the country, which commenced the year following at the mouth of the Pascataqua. Several patents of inferior extent were subsequently issued, one of which conveyed the Pemaquid tract of country, now Bristol, which is regarded as the oldest permanent settlement in Maine. In 1635 the council conveyed to Georges a separate title to the portion of the former grant east of the Pascataqua, having previously confirmed in the possession of the western part Mason, from whom it received the name of New Hampshire. Georges obtained for himself, by royal charter, the powers of lord palatine, as exercised by the Bishop of Durham; appointed a board of counsellors; and in 1640 assembled a court, at which the inhabitants of the several plantations appeared, and renewed their oath of allegiance to the lord proprietor. Sir Ferdinando, who was a royalist, had his share of the disasters with which the adherents of Charles I. were overwhelmed; and dying in 1645, he left his estate to his son John Georges. During the civil commotions which confounded alike titles and property, one Colonel Rigby laid claim to forty square miles of the best part of Georges' inheritance, which claim was recognised in 1646; and the small remaining portion of Maine, having elected a governor, petitioned parliament in 1650 to constitute them a distinct jurisdiction, "a part of the commonwealth of England," but without success. Their apprehensions of falling into the hands of the Puritans were soon realized. In the year 1652, nearly the whole of Maine was claimed by the colony of Massachusetts Bay, under the pretext that it was embraced in their charter; and they succeeded for a time in exercising supreme control over it. In 1665, after the restoration of Charles II., commissioners were appointed to visit Maine, who declared the province to be under the protection and government of the king, and nominated a magistracy. No sooner had they quitted the country, however, than the authorities of Massachusetts resumed their sway, and the inhabitants were compelled to yield an unwilling submission. But Georges, the legal proprietor, at length succeeded in obtaining a restitution of his title, and the authorities of Massachusetts Bay were summoned to appear at Whitehall. Determined to retain possession of the country, they instructed their agents to make a purchase of it should the decision go against them, which happening to be the case, Georges disposed of his title to the province for L.1250. This transaction took place in 1677–78. Immediately after purchasing Maine, the council of Massachusetts proceeded to organize a provincial jurisdiction, constituting it a county under the name of York; an arrangement which lasted, without any change, till 1760, when the counties of Cumberland and Lincoln were incorporated, and the county of York was reduced to nearly its present limits. After the independence of the colonies was established, Maine was styled a district, although its connection with Massachusetts remained the same until it was erected into an independent state in the year 1820. See the article MAINE.

Plymouth, the next colony, was founded by a body of Puritans, who had removed from England to avoid religious persecution, and landed at a place in the new world, to which, in 1620, they gave the name of Plymouth. They entered into a voluntary compact, by which they bound themselves to observe certain laws and ordinances which should be framed and issued to promote the general good of the colony. This is the earliest American constitution, and is dated the 11th of November 1620, and signed by forty-one persons. The government was administered by a governor, chosen annually by the people, and by seven persons called assistants, elected in the same way. It was at first a pure democracy, but in the year 1639 a house of representatives was established. The political affairs of this colony are closely interwoven with those of Massachusetts, with which it was incorporated in 1772.

The colony of Massachusetts Bay, which has acted so conspicuous a part in the affairs of New England, originated in a number of individuals having, in 1628, obtained from the Plymouth Company a grant of that part of New England lying three miles south of Charles River, and the same distance north of the Merrimac, and extending from the Atlantic to the South Sea. In the following year they obtained from Charles I. powers as the company of Massachusetts Bay, being authorized to elect a governor and eighteen assistants annually, to hold courts, and to make laws and regulations for the colony. Settlements were immediately formed at Salem, Charleston, Boston, and other places, and the settlers soon obtained permission to transfer the charter and government to New England, thus rendering that the constitution of a state which was merely designed to constitute the organization of a company. In 1634 the people claimed a participation in the government, and declared that the general court (the name which the two houses of legislature in Massachusetts still bear) alone had power to frame laws, levy taxes, and fill up offices. This, therefore, became a fundamental part of the constitution ; but disputes arising between the assistants and the deputies of the people, who met in the same room, it was determined, in 1644, that the legislature should consist of two separate bodies, each having a negative on the other. No judicial authority was given by the charter, but the power was in fact assumed and acted upon. Courts of justice were created, and in criminal cases the Mosaic law was mainly followed.

Connecticut was an offshoot from Massachusetts, and at first was governed by magistrates empowered by the legislature of the parent colony. But in 1639 they framed a constitution for themselves, the substance of which was contained in the charter granted by Charles II. in 1662, and continued, without any material alteration, to be the fundamental law of the state until 1818. New Haven, which was settled in 1637 by a body of Puritans, continued to exercise powers of government as a separate body until 1662, when the colony was by charter included in Connecticut.

In the year 1634, a minister of the name of Williams having been banished from Massachusetts on account of his religious creed, settled at Providence, whither he was followed by a few adherents. Four years afterwards, a lady, banished from the same place for the same reason, purchased Rhode Island from the Indians ; and thus two new communities, with distinct governments, were formed. In 1643, commissioners of plantations had been created ; and from these a charter of incorporation was obtained for the inhabitants of the towns of Newport, Portsmouth, and Providence, under the designation of the Providence Plantations, with full powers to adopt a form of government, and to rule themselves. In the same year in which the commission was appointed, the colonies of Massachusetts, New Plymouth, Connecticut, and New Haven, formed a confederacy, under the title of the United Colonies of New England, which lasted about forty years, when James II. deprived them of their charters. This confederation was exactly the future union of states in miniature. According to the articles of the confederacy, the colonies bound themselves by a perpetual league of friendship and amity for offence and defence, whilst individually they managed their own affairs. Two commissioners of each of the confederates formed a board for transacting the affairs of the confederacy generally. This was just congress in embryo. During the ascendency of Cromwell the New England colonies were highly favoured ; but the restoration of royalty subjected them to suspicion, and, as we have seen, to scrutiny. In the year 1664, royal commissioners were appointed to visit them, and hear and decide all their complaints, and appeals, civil, criminal, and military, thus bringing the whole under the immediate superintendence of the crown. But, as Lord Clarendon expressed it, the colonies were already hardened into republics, and the commissioners found it impossible to execute their powers. Arbitrary measures were resorted to, to bring the refractory provinces under proper control, but without effect ; so that, by the year 1687, it had been declared that they had forfeited their charters and their liberties, which were accordingly seized by the crown. Sir Edmund Andros, the governor, put himself at the head of a body of troops, and advanced to Connecticut for the purpose of seizing the charter. The assembly was convened, and the charter was conveyed to the room, where they met to confer with Andros. The conference was prolonged till night, when the people without made a rush into the room, extinguished the lights, and secreted the charter in an oak, which is still shown at Hartford. In many places the inhabitants refused to pay taxes, and a rumour having been circulated that the Prince of Orange had landed in England, the people of Boston rushed to arms, seized the governor, and the captain of a frigate which lay in the harbour, compelled the castle to surrender, and thus effected a complete revolution. Subsequently to these events, Connecticut and Rhode Island resumed their former charters ; but, in 1672, a new one was granted to Massachusetts, by which the appointment of the governor was vested in the crown. It is superfluous to narrate the wars with the Indian tribes in which these colonies were involved, or those in which Britain finally annihilated the power of France in America. An account of these belongs more to the general history of the United States than to the present sketch. Vermont, the only New England state which remains to be mentioned, took no lead in these transactions ; and any event of importance in which it was concerned will be found related in the article New York. (R. R. R.)

NEWENT, a market-town of the county of Gloucester, in the hundred of Botloe, 108 miles from London. It is a small town, and what little trade it enjoys arises from its market on Friday, and from the canal from Gloucester to Ledbury, which passes near to it. The inhabitants amounted in 1801 to 2354, in 1811 to 2538, in 1821 to 2660, and in 1831 to 2859.

NEW FOREST of Hampshire, in England, is a tract of at least forty miles in compass, which had many populous town and villages, and thirty-six mother churches, until it was destroyed and turned into a forest by William the Conqueror. As this large tract lay many ages exposed to invasions from foreigners, Henry VIII. built some castles in it. It is situated in that part of Hampshire which is bounded on the east by Southampton River, and on the south by the British Channel. It possesses advantages of situation, with respect to the convenience of water carriage and nearness to the dock-yards, superior to every other forest, having in its neighbourhood several ports and places of shelter for shipping timber, amongst which Lymington is at the distance of only two miles, Bewley about half a mile, and Redbridge three or four miles from the forest ; and the navigation to Portsmouth, the most considerable dock-yard in the kingdom, is only about thirty miles from the nearest of these places. This is the only forest belonging to the crown of which the origin is known. Doomsday-book contains the most distinct account of its afforestation by William the Conqueror. The contents of every field, farm, or estate, afforested, in hides, carucates, or virgates, by which the extent of land was then computed, together with the names of the hundreds and villages, and of the former proprietors, which are for the most part Saxon ; the rent or yearly value of each possession, and the tax which had been paid for it to the crown during the reign of Edward the Confessor, before the inhabitants were expelled, and that part of the country laid waste ; are all to be found in that curious and venerable record. Wishing to discover the original extent of the forest, we had extracted all that relates to it in that ancient survey ; but the extract is far too voluminous for insertion. The names of many of the places having since that time

Newfound-land.

been changed, it is difficult to ascertain with precision what were then the limits of the forest. The oldest perambulation we have met with is amongst the Pleas of the Forest, in the eighth year of Edward I. preserved in the chapter-house at Westminster. The boundaries there described include all the country from Southampton River on the east to the Avon on the west, following the sea-coast as far as the southern boundary between these rivers, and extending northwards as far as North Chadeford, or North Charford, on the west, and to Wade and Owerbridge on the east; and the greater part, if not the whole, of that extensive district, is mentioned in Doomsday-book as the forest belonging to the crown. Another perambulation was however made in the twenty-ninth of the same king, and leaves out a great part of the country contained in the former. This perambulation, which is preserved in the Tower of London, confines the forest to limits which, as far as can be traced, appear to have been followed in the twenty-second year of Charles II. when the forest was again perambulated. By the *Charta de Foresta*, all lands not belonging to the crown which had been afforested by Henry II. Richard I. or King John, were to be disafforested; but as no provision was made for the reduction of the more ancient afforestations, it is easy to account for the great diminution of this forest in the reign of Edward I. who was not a prince likely to submit to any encroachment on his rights. The perambulation of the twenty-second of Charles II. is the last which is found upon record, and contains the actual legal bounds of the forest. According to the perambulation last mentioned, and the plan founded thereon, the forest extends from Godshill on the north-west to the sea on the south-east, about twenty miles, and from Hardley on the east to Ringwood on the west, about fifteen miles, and contains within those limits about 92,365 acres statute measure. The whole of that quantity, however, was not forest land, nor is it now the property of the crown. There are several manors and other considerable freehold estates within the perambulation, belonging to individuals, to the amount of about 24,797 acres; about 625 acres are copyhold or customary lands belonging to his majesty's manor of Lyndhurst; about 1004 acres are lease-hold under the crown, granted for certain terms of years, and forming part of the demised land revenue, under the management of the surveyor-general of crown lands; about 901 acres are purprestures or encroachments on the forest; about 1193 acres more are enclosed lands held by the master-keepers and groom-keepers, with their respective lodges; and the remainder, being about 63,845 acres, consists of woods and waste lands of the forest. To perpetuate the spot where William Rufus was killed by the glance of an arrow shot at a stag, a triangular stone was erected in 1745.

NEWFOUNDLAND, an island in the North Atlantic Ocean, lying on the north-eastern side of the Gulf of St Lawrence, between the parallels of 46. 40. and 51. 31. north latitude, and the meridians of 52. 44. and 59. 31. longitude west of Greenwich. It is separated on the north-west from Canada by the Gulf of St Lawrence; on the north and north-east it is divided from the coast of Labrador by the strait of Belleisle, which is about fifty miles long by twelve broad; on the south-west it approaches Cape Breton, so as to form the main entrance from the Atlantic Ocean into the gulf; and along the whole of its eastern side extends the Atlantic Ocean. Its form is somewhat triangular, but without any approach to regularity, being on all sides, at very short intervals, indented by broad and deeps bays, creeks, harbours, caves, and estuaries. In this respect its shores resemble those of Nova Scotia, and the serrated appearance which they have on maps is attributable to the same cause. A vast and uninterrupted body of water impelled by the trade-wind from the coast of Africa to the American continent strikes this part of it with tremendous violence, and working away the softer strata, forms those numerous arms and inlets of the sea which we have mentioned. The same powerful agent, combined with the influence of the Atlantic Ocean, has produced the same effect upon other parts of the coast besides those exposed to its first attack. The coast outline, the only part of Newfoundland which has been satisfactorily explored, is rock, girt all round with abrupt fissures, and having some lofty headlands on the south-west side. Its width, at the broadest part, between Cape Ray and Cape Bonavista, is about 300 miles; its extreme length, measured on a curve from Cape Race to Griquet Bay, is about 419 miles; and, exclusively of the bendings and inferior inflections of the coast, its circumference may be estimated at about 1000 miles, the whole comprehending an area of 36,000 square miles.

Newfound-land.

This vast island reposes upon an immense bank, a succession of which has been observed all the way to Nova Scotia. It is apparently a mass of solid rock, having a very wild and rugged appearance from the sea, and being any thing but inviting. On its south-eastern quarter Newfoundland is formed into a peninsula of twenty-six leagues in length by from five to twenty leagues in breadth, the isthmus which unites it with the main land being not more than four miles in breadth. This peninsula is called Avalon. To the north of it, and on the eastern side of the island, lies Trinity Bay, which is separated from that of Bonavista by a narrow neck of land, the point of which is Cape Bonavista. A long neck of land also divides Trinity Bay from Conception Bay on the northern side of Avalon. This bay ranks as the first district in Newfoundland, as well on account of the spirit and enterprise of the inhabitants who people its shores, as from its natural advantages of large harbours, coves, and the like. The scenery on this part of the coast is majestic, wild, and calculated to strike the beholder with awe. On the eastern side of Conception Bay are several islands, one of which is Bell Isle, so called from the shape of a remarkable rock close to its western side. This island is about six miles in length, and extremely fertile. Seven leagues distant from Cape St Francis, the eastern boundary of Conception, are the bay and harbour of St John's, the capital of Newfoundland. A succession of bays indent the coast all round the peninsula of Avalon, the principal of which are, Trepassey Bay, which has a large secure harbour and excellent anchorage, with a considerable fishery carried on in the coves and creeks; and Placentia Bay, which is about sixty miles deep and forty-five broad, lying between Cape St Mary and Cape Rouge, which are fifteen leagues apart. It is very spacious, with several rugged islands near its head. The port and town of Placentia lie on the eastern side, as well as the chief harbour, which, although it can only be entered by one vessel at a time, affords anchorage for one hundred and fifty. Placentia Bay contains several other harbours. It is separated from Fortune Bay by one of those long and narrow necks of land which are so common in the island. Fortune Bay is from sixty to seventy miles deep, and from twenty to thirty miles broad, receiving many rivers from the island lakes, and containing numerous harbours, the principal of which is Fortune Harbour on the eastern side. St Pierre and Miquelon Islets are situated at the mouth of Fortune Bay. They were ceded to France in the year 1814, and the former contains a harbour which is the rendezvous of the French shipping, and the residence of the governor. From this point, all along the south side of Newfoundland to Cape Ray, which forms the north-east entrance of the Gulf of St Lawrence, there are numerous bays, but none of sufficient size or importance to require particular description. On the western side, formed by Cape Anguille and Cape St George, is the Bay of St

Newfoundland. George, a large and deep inlet of the sea, into which several rivers emerging from lakes in the interior empty themselves. Further to the north is the Bay of Islands, formed by three arms, through which several rivers discharge their waters. One of these, called the Humber, is the most considerable yet discovered, its course having been traced for one hundred and fourteen miles to the north-westward, where it issues from a cape of ten leagues in length. As its name would indicate, this bay contains a number of islands, but none of any particular consequence. The next large indentation of the sea on the western side of Newfoundland is Bonne Bay, which has also rivers communicating with the lakes inland to Point Rich. The next bay is called Ingornachoix Bay, which contains two harbours; and to the north of it is St John's Bay, which receives the waters of Castor's River. Along the straits of Belleisle, which separate Newfoundland from the coast of Labrador, are a few inconsiderable inlets; but beyond Cape Norman, the north-west point of the island, is a large bay called Pistolet Bay, bounded by Cape Barut. On the northern extremity of Newfoundland are Griquet Bay and Hare Bay, a deep gulf, the bottom of which intersects the island for two thirds of its breadth at this point, branching off into innumerable bays and coves, sheltered by lofty hills. From this haven to White Bay, a very large inlet of the sea, on the eastern side of the island, and thence to Cape St John, the coast is indented at short distances by commodious and much-frequented harbours. The Bay of Notre Dame and the Bay of Exploits are of great extent, and contain a vast number of islands, together with a thriving settlement called Twilingate. The river Exploits is about seventy miles long, but its navigation is obstructed by rapids, some of which have a velocity of nearly ten miles an hour. This river connects the Red Indian Lake, a large sheet of water in the interior, with the Atlantic. Gander Bay is much of the same description; and all have important salmon fisheries. From Cape St John to Cape Freels the coast is a continuation of ledges, shallows, islands, and rocks, but affords excellent fishing grounds. Bonavista Bay contains several islands, and is itself indented by a number of small inlets and harbours. To the south of it is Catalina Bay, containing Ragged Harbour, which concludes the circuit of the island.

After the exterior aspect of Newfoundland has been described, the interior comes naturally to be noticed. But this has been very imperfectly explored, and therefore is but little known. In 1823, a Mr M'Cormack succeeded in traversing its breadth from Conception Bay on the east to St George's Bay on the west; and from his account it appears, that this portion of it at least is much intersected with lakes and rivers, but poorly wooded, and of a rocky and barren soil. In this respect the island differs greatly from the other North American colonies, producing little timber but what is dwarf and stunted, except on the margins of bays and rivers, where spruce, birch, and poplar sometimes grow to a considerable size. Several high hills, supposed to be situated near the centre of the island, can be discerned from the sea; but the inland country is represented as generally level, so that lakes, rocks, marshes, and extensive alluvial savannahs or plains, with occasional elevations, constitute its characteristic features. The geology of Newfoundland is nearly the same as that of the coast of Labrador. The island, it appears, abounds with minerals of various sorts. Coal and lime have been wrought in more than one part with some success; and there is little doubt as to the existence of copper, iron, and other mines, but it is not likely that they are very productive. There are excellent gypsum quarries near Cape Ray, and there is also a quantity of the mineral called marcasite, copperas stone, and horse gold, which the early discoverers mistook for the genuine metal. With regard to the productions of the island, Mr Bouchette observes:[1] "At the heads of the bays, and along the rivers, there are many tracts of land formed of deposits washed from the hills; the soil of which tracts is of much the same quality as that of the savannahs in the interior of America. These lands might be converted into excellent meadows, and if drained to carry off the water which covers them after the snows dissolve, they would yield excellent barley and oats. The rich pasturage which the island affords adapts it in an eminent degree to the breeding and raising of cattle and sheep, insomuch as to authorize the belief that it might produce a sufficient quantity of beef to supply its fisheries. Firs of various sorts, poplars, birches, and a few maple trees, are found in Newfoundland, with a variety of shrubs. Most of the English common fruits arrive at perfection, and various grasses grow spontaneously in all the plains. The wild animals are nearly the same as those of Prince Edward Island, and indeed of our other American colonies. The Newfoundland dog is an animal whose peculiarities and virtues are too well known to need any detail in this place; it is, however, generally considered that the true original breed exists now only on the coast of Labrador.

"The climate is severe, and the winter long; but it has generally been represented more unfavourable than strict truth will warrant. The excess of humidity and constant visitation of dense fogs, which have been commonly ascribed to these coasts, is by no means a continual visitation. The sea-winds often bring a considerable quantity of vapour to the southern and eastern coasts; but it is only when the wind blows from the sea that this inconvenience is felt. The range of the thermometer is nearly the same as in Canada, but as the length of the island extends over nearly five degrees of latitude, it will of course vary. The harbours on the Atlantic shore are generally freed from their icy bonds earlier than any other within the Gulf of St Lawrence, and the western shore is seldom visited by fogs. The heat of the summer is sometimes oppressive in the day-time, but the mornings and evenings, as in almost all insular situations, are temperate and agreeable. The breaking up of the winter, when the vast shoals of ice formed in the northern regions are driven along the coast by the winds, is the most disagreeable time of the year. The inhabitants, however, maintain excellent health, and, notwithstanding the exposure and hardships of a fisherman's life, frequently attain a remarkable longevity."

The most remarkable feature connected with Newfoundland is the fogs above alluded to. Those of the Gulf of St Lawrence are attributed to the coldness of the gulf-waters, which is supposed to be permanent a few feet below the surface, as well as at great depths. This cold water is brought to the surface by winds, and, reducing the temperature of the air below the dew point, forms vapour. The fogs on the banks of Newfoundland are also, in all likelihood, caused by cold currents of water being brought to the surface. On the great bank the surface of the water is many degrees colder than it is in the neighbouring sea, and much less than that of the gulf-stream, which is within a short distance of it.

The most valuable vegetable productions of the island are potatoes and cabbages; and next to these turnips, carrots, parsnips, pease, radishes, and most garden roots, yield the most abundant crops. Besides the great staple of the island, fish, the numerous large and small sheets of water abound in divers kinds of excellent trout and eels of a great size, and lobsters, lance, herrings, mackerel, salmon, are in great abundance; plaice, sole, hallibut, and thornback, are

[1] Bouchette's British Dominions in North America, vol. ii. pp. 187, 188.

Newfoundland. likewise found on the coast. The capelin arrives periodically in such immense shoals as to change the colour of the sea. Herrings likewise arrive during spring and autumn in prodigious numbers. As a product of the coast may be mentioned kelp, which, with other sea-weed, is used as manure.

The importance of this colony has exclusively arisen from its fisheries. The different settlements amount to between sixty and seventy in number, and are scattered on the shores of the eastern and southern sides of the island, but principally on the former. There are, indeed, some inhabitants on the western shore, near its southern extremity; but they do not extend to the northward of St George's Bay, although the vicinity of that bay has proved extremely fertile. The settlements are generally formed at the heads of the bays, particularly Conception Bay, thence to St John's, and southward to Cape Race. The principal are, besides St John's, the Bay of Bulls, Brigus, Cape Broyle Harbour, Ferryland, Fermore, and Renowes. St John's, the capital of the island, is a place of considerable strength, situated about seventy miles to the north of Cape Race, and about one hundred and twenty south of Twilingate Island in the Bay of Exploits, which is the most northerly settlement, latitude 47. 35. north, longitude 52. 48. west. The harbour is one of the best in Newfoundland, being formed between two mountains, the eastern points of which leave an entrance, called the Narrows. This is the only assailable part, but it is so well defended, that any vessel attempting to force an entrance would inevitably be destroyed. There are about twelve fathoms of water in the middle of the channel, with tolerably good anchorage ground. The most lofty perpendicular precipices rise to an amazing height upon the north side, and the southern shore appears less striking in its altitude, only from a comparison with the opposite rocks. There is a light shown every night on the left side of the entrance, where there are also a small battery and a signal-post. Other batteries of greater strength appear towering above the rocky eminences towards the north. At about two thirds of the distance between the entrance and what may properly be termed the harbour itself, there is a dangerous shelf called the Pancake, opposite the chain rock, so called from a chain which extends across the strait at that place, to prevent the admission of any hostile fleet. There are other fortifications besides those already noticed, planted upon the heights around the town, so as to render St John's perfectly secure against any sudden attack. Fort Townshend is situated immediately over the town, and is the usual residence of the governor. Forts Amherst and William are more to the north; and there is also a small battery perched on the top of a single pyramidal mount, called the Crow's Nest. The town itself forms one long straggling street, extending nearly parallel to the shore on the north side of the port, from which branch out several narrow lines of houses, that can only be called lanes. The houses are chiefly built of wood, although diversified by some of brick and a few of stone; but they are most irregularly placed, in consequence of an act of the British legislature, passed in 1820, after the great fires, which directs, that where the houses are built of stone, the street shall be forty feet in width, and where of wood, fifty; so that all the stone houses project ten feet into the street. The principal feature of the town consists in its multitude of wharfs and fishing stages, which entirely line the shore. The government wharf is a fine broad quay, open to the accommodation of the public. The roadway of the main street is very rugged and irregular, and the general appearance of the town indicates exactly what it is, viz. a fishing station. St John's has repeatedly and severely suffered from fires. In 1815, a great amount of property was destroyed by a visitation of this sort, which was repeated in November 1817, with increased severity, property to the amount of L.500,000 having been destroyed. Within a few days afterwards, another conflagration consumed nearly all of the town that had been left by the former one; and in August of the same year a fourth calamity nearly completed its destruction. There are places of public worship of various denominations at St John's, two school-houses, and a book society; and five newspapers are also published. The population of the town is constantly fluctuating. At the height of the fishing season it is perfectly crowded, but the greater part of these are strangers, who return with their vessels to Europe. The resident population may be estimated at 11,000. The society of this town has for some years rapidly advanced in respectability and civilization; partly on account of several merchants deeply engaged in trade having settled here, and many of the industrious inhabitants having raised themselves to comparative opulence; and partly owing to the administration of justice having been placed upon a more permanent footing than formerly. The settlements extend almost continuously along the southern shore, as far as Fortune Bay; and at most of the harbours there are places of public worship. The establishment at St George's Bay is perhaps more agricultural than any other on the island; but Conception Bay, being the most populous, requires more particular notice. "Harbour Grace is a good port," says Captain Robinson; "and the town is considerable, and of a respectable appearance. Conception Bay, in which it is situate, is the richest and most populous country district in Newfoundland, containing altogether about 14,600 inhabitants, a large proportion of the 86,000 which the most recent census (1820) gave for the whole population of the island. They are distributed in a number of small towns, or fishing and agricultural hamlets; near another of which, Port Grace, a remarkable basin is hollowed out in the cliffs by the action of frost, or the more certain operation of time, in the decaying slate clay of which the rocks are composed. First an arch is entered twenty feet wide by twenty feet high, and beyond is the basin itself, which is about 300 feet in circumference, and surrounded by perpendicular rocks 120 feet in height, with a border of dwarf spruce at top. At one corner, a little exit among broken masses of rock carries off the superfluous water; the depth near the centre of the cavity is about fourteen feet." On leaving the harbour, the same writer observes: "The harbour is good; and though the space between the end of the bar and the north shore is rather narrow, a large ship, well handled, may beat through, or back and fill in and out, with the tide."

Near the extremity of Port Grace Harbour are the remains of a supposed ancient colony, which some have attributed to the Danes or Icelanders; a sea-king of the latter people having, according to tradition, been driven by stress of weather upon this part of the coast about the year 1000. The ruins were discovered by a party of settlers, who, proceeding up a river which falls into Conception Bay, observed, at the distance of six or seven miles above the bay, the appearance of stone walls rising just above the surface. "On removing the sand and alluvial earth, they ascertained these to be the remains of ancient buildings, with oak beams, and mill-stones sunk in oaken beds. Enclosures resembling gardens were also traced out, and plants of various kinds were found growing about the place, not indigenous to the island; but the most decisive proof of these ruins being the remains of an ancient European colony, was drawn from the different kinds of coins found about them, some of Dutch gold, which the inhabitants considered to be old Flemish coins; others of copper without inscriptions." Captain Robinson, however, throws doubt on the antiquity of the buildings, and asserts that they are not older than the settlement of Lord Baltimore in 1623.

Newfoundland is justly considered as a very important colony, both from the value of the fisheries there established, and also on account of the hardy race of seamen who are trained up in that useful pursuit. In the article FISHERIES in this work will be found an account of the early trade of the colony, so that, in order to show its present condition, it may be sufficient to give the returns applicable to a recent period. The following table shows the progress of trade since 1822.

Years.	Inwards from								Outwards to							
	Great Britain.		British Colonies.		Foreign States.		Total.		Great Britain.		British Colonies.		Foreign States.		Total.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
1822	297	38,167	274	20,818	178	22,037	749	81,022	146	17,457	281	24,299	321	38,859	748	80,615
1823	289	39,813	254	21,015	201	23,650	753	84,478	116	12,238	272	25,725	353	42,569	741	80,532
1826	279	35,196	295	24,594	277	33,316	851	93,406	171	19,770	326	30,557	328	40,223	825	90,550
1827	279	37,595	268	22,417	239	30,368	786	90,380	164	20,182	311	33,114	291	35,667	776	88,963
1829	275	38,608	319	17,507	197	24,915	791	91,030	147	17,766	350	36,544	278	34,883	775	89,193
1830	286	39,856	321	26,363	221	28,204	828	94,423	158	19,054	357	37,610	284	35,718	799	92,382
1831	274	37,577	385	30,643	218	20,349	877	96,569	181	21,764	432	43,159	223	27,575	836	92,498
1832	268	36,265	362	27,881	215	25,783	845	89,929	167	20,221	430	39,113	199	25,111	796	84,445
1833	251	35,171	419	33,287	222	26,784	892	95,242	151	18,515	450	42,327	244	30,118	845	90,960

A more detailed view of the shipping employed with different countries is thus shown by custom-house returns.

	Year ending 5th January 1833.						Year ending 5th January 1832.					
	Inwards.			Outwards.			Inwards.			Outwards.		
	No.	Tons.	Men.	No.	Tons.	Men.	No.	Tons.	Men.	No.	Tons.	Men.
United kingdom	245	34,322	1969	150	18,280	1110	257	34,704	2024	164	19,728	1203
Guernsey and Jersey	6	849	53	1	235	12	11	1,561	103	3	493	33
British West Indies	54	5,490	356	73	7,796	503	54	5,605	379	71	7,821	515
British North America	363	27,522	1535	371	33,748	1867	308	22,276	1158	355	30,871	1595
Foreign Europe, British vessels	132	16,276	1017	183	22,137	1413	159	19,995	1413	173	21,500	1333
Foreign Europe, Foreign vessels	5	565	40	...	...	...	...	...	...	2	336	14
United States, British vessels	68	7,938	451	29	3,515	206	50	5,146	279	21	2,330	137
United States, Foreign vessels	5	849	42	...	...	...	3	409	14	1	73	4
Madeira	...	...	...	...	...	...	2	163	10	1	102	6
Azores	5	458	27	6	458	26	1	70	5	1	70	4
Brazils	2	415	23	23	3,896	225	...	...	...	...	...	...
Gibraltar	2	275	14	6	789	44	...	...	...	4	421	26
St Pierre	3	112	12	3	112	12	...	...	...	...	...	...
Porto Rico	2	171	13	...	...	...	...	...	...	...	...	...
Total	892	95,242	5552	845	90,966	5418	845	89,929	5385	796	83,745	4870

The following table presents a view of the principal exports from Newfoundland.

	1830.	1831.	1832.	1833.
Dry cod fish.....quintals	948,463	755,667	654,053	663,787
Seals' skins...No. of casks	300,682	559,342	682,803	501,436
Cod and seal oil.....tons	8,306	12,371	13,118	10,539
Staves.............number	25,204	32,568	29,000	40,679
Salmon...............casks	4,439	3,606	2,924	2,705
Herrings...........barrels	1,083	1,799	1,064	3,969
Mackerel...............do.	390	456	984	606
Tongues, sounds, and caplins.... casks	1,759	2,092	1,646	819

Besides these articles, various kinds of skins are exported, and also whalebone, pine-board, juniper plank, billets, knees, oars, staves, and the like; but the above returns show that the cod and seal fisheries are by far the most important branches of the trade of Newfoundland.

For an account of the nature of the Newfoundland fisheries, and their importance to Great Britain, the reader is referred to the article FISHERIES.

The principal imports consist of bread, flour, pork, and beef, butter, rum, molasses, wine, brandy, and gin, coffee, tea, sugar, oatmeal, salt, pease and beans, lumber, shingles, and the like. The value, together with that of the exports, has been as follows.

Years.	Imports valued in Sterling Money.				Exports valued in Sterling Money.			
	From Great Britain.	From British Colonies.	From Foreign States.	Total Value of Imports.	To Great Britain.	To British Colonies.	To Foreign States.	Total Value of Exports.
	L.	L.	L.	L.	L.	L.	L.	L.
1822	656,327	177,423	34,002	867,752	245,578	82,952	400,668	729,198
1826	204,753	131,090	179,600	512,443	293,745	121,746	343,814	759,305
1827	549,816	157,731	181,714	889,261	316,596	116,513	331,477	764,586
1830	546,839	130,286	91,291	768,416	252,389	140,520	292,771	685,680
1831	530,954	177,958	102,441	829,353	393,584	132,258	277,690	803,532

Newfoundland.

The total value of the Newfoundland trade may be estimated, in round numbers, at L.2,000,000 sterling per annum, independently of its great importance in a maritime point of view. But besides the trade in fish and oil carried on by Great Britain in the British seas, that of America and France is also of immense extent and importance. To France it averages about 300,000 quintals of fish, and not only are bounties given for this article, and for the vessel so much per ton, but also for those men employed who have never before been at sea. No bounty whatever is paid by our government, so that our fishermen have to compete under the greatest disadvantages. But this is not all. In 1814, the French obtained a right to a large extent of the coast fishery, or rather the right which they had enjoyed previously to 1792 was then restored, and the islands of St Pierre and Miquelon were ceded to them, to serve as a shelter for the French fishermen. This privilege, which was conferred by treaty, they have rendered exclusive, and so late as 1833 drove some English vessels off the coast of Newfoundland, not allowing them to fish upon the shores of their own island. The Americans also take every possible advantage of the privileges granted by us as regards the latitude fixed, fishing close to the land during night; and they likewise injure their neighbours by throwing their offal into the sea. Of the entire quantity of cod-fish which they take, not less than 1,500,000 are reckoned as caught on our own shores. The regular trade of Britain, besides suffering from the causes mentioned, is seriously injured by the extensive smuggling which the foreign fishermen carry on. From 1815, when the French and American vessels were allowed the privilege of fishing in the British seas, till 1820, the tonnage of the British vessels employed in the trade fell off about one third. The deep-sea fishery, in particular, is now almost abandoned by the English to the Americans and French. Indeed every thing relating to British interests, in connection with the Newfoundland fisheries, appears to have been grossly mismanaged or neglected.

The affairs of the island are administered by a house of assembly, consisting of fifteen members chosen by the people, to which is added a legislative and executive council. The laws are in the English language, and are administered by circuit courts. There is no militia in the island, and the police force is small. The revenue is derived from custom-duties, amounting to about L.15,000 per annum, and licenses, L.1000. To meet the expenditure, a parliamentary grant of about L.10,000 was for several years given; but this was withdrawn in 1832, and since then the revenue has not covered the expenditure by about that amount, so that its restoration has been found necessary. The moral aspect of Newfoundland is rather encouraging. Considerable unanimity has usually existed amongst the different religious persuasions, consisting of Wesleyans, Roman Catholics, and Congregationalists; the dissenters being generally more numerous than the Episcopalians, over whom there is an archdeacon. The Catholic church is governed by a bishop. There are several newspapers published in the island, and of late years a taste for literature has been diffusing itself. There are between thirty and forty schools, as well for adults as for children. At St John's there is a commercial society, out of which a chamber of commerce is chosen annually, to watch over and promote the trade and fisheries. There are several benevolent societies and two benefit societies. The population of Newfoundland for several years was as follows:

	Males.	Females.	Total.
1822–23	31,746	20,411	52,157
1827–28	34,617	23,471	58,088

To these numbers must be added 2000 individuals distributed over distant parts of the coast, which could not be visited by those who took the census. The population necessarily fluctuates greatly, so that much difficulty is experienced in obtaining correct returns. The resident inhabitants are now (1837) reckoned at about 90,000.

When Newfoundland was first visited, it was found to contain two distinct races of aborigines; the one termed Red Indians, and the other Esquimaux. Both are now almost extinct; the former, it is supposed, is entirely so, as deadly feuds were waged between them and the early settlers. Besides, the Mic-mac Indians, who were introduced into the island from Cape Breton and Nova Scotia, carried on with the Red Indians an exterminating war, which proved far more fatal to them than the hostilities of the Europeans. A female of this tribe was captured in 1818, and from her a vocabulary of their language was obtained.

Without dwelling upon the tradition which represents Newfoundland as having been settled at a very early period by one Biron, a sea-king or pirate of Iceland, we have authentic evidence of its re-discovery by John Cabot, on the 24th of June 1497. Sailing under the commission of Henry VII. in these seas, he descried a headland, which, as a lucky omen, he called Bonavista, a name which it still retains. It was at that time inhabited by native Indians, three of whom he brought home, clothed in skins, and speaking a language which no person understood. It was afterwards visited by navigators from France and Portugal, who reporting favourably of the abundance and excellency of its cod fishery, European fishermen were soon attracted to its coasts. In 1536 an English vessel attempted to winter upon the island, but the crew nearly perished from starvation. Not deterred by this failure, however, nor by that of a former attempt, Sir Humphrey Gilbert, in 1583, landed on the island with two hundred followers, and, under a patent of Queen Elizabeth, took quiet possession of the country. But too desirous of prosecuting his discoveries, his crews became disaffected, and having separated into two parties, one of them returned home. Most of those who followed him were lost in a gale of wind off the Sable Island, and the remainder perished, along with himself, on their voyage homewards. Subsequent attempts were made to explore and settle Newfoundland, but it was not until the year 1623 that the first colony was established under Sir George Calvert, afterwards Lord Baltimore. His son was made governor of the colony, which he named Avalon, and soon afterwards proceeding thither himself, it increased and flourished under his auspices. Ten years subsequently Charles I. issued a regulation for "governing of his majesty's subjects inhabiting in Newfoundland, or trafficking in bays," &c.; and about the same time Lord Falkland sent a colony from Ireland. Other individuals obtained grants of land; and about the year 1654, fifteen settlements, comprehending three hundred families, had been made on the island, notwithstanding the constant bickerings between the English and French, the latter having established a colony at Placentia. On the breaking out of the war after the accession of William III., these assumed a more serious character, and, after various recriminations, St John's was compelled to surrender to the French in 1696. The captors set fire to the fort and town, and destroyed most of the British settlements. To repair these losses, our government despatched a squadron; but the cowardice of one commander and the ignorance of another frustrated the design. The re-establishment of peace put an end to hostilities for the time; but they were resumed in 1702, during which year most of the French settlements were destroyed, and a great many fishing-boats were burned or captured. In the following year an expedition miscarried, and this circumstance encouraged the French to attempt the conquest of the whole island in 1705. For this purpose five hundred men were despatched from Canada; but being repulsed from Petty Harbour, a port within nine miles of St John's, they extended their ravages over the different settlements as far as Bonavista. In 1706 the French trade received a severe blow from an English commander, who, with only ten vessels, crippled the armed force on the station, and destroyed a number of the enemy's vessels in the harbours along the coast. These disasters, however, did not deter the French from attempting the permanent expulsion of the English. In the year 1708 they completely demolished the town of St John's; and shortly afterwards Carbonia, the only settlement of consequence remaining in our hands, was partially destroyed. From this time until the conclusion of the peace of Utrecht the French remained in quiet possession of Newfoundland; but by this treaty the island, with all the adjacent ones, was declared to belong to Great Britain, the French being only allowed the use of the two islets of St Pierre and Miquelon. The final conquest of all the American colonies extinguished any claims which the French might set forth to possession in these seas; and they were glad to receive back at the peace of 1763 the privilege above conferred. The revolutionary war in America occasioned fresh disputes as to the right of fishing upon the banks of Newfoundland. The New Englanders had hitherto enjoyed the right of taking fish, and on this being resisted, they retaliated, by refusing to supply the colony with many articles of provision upon which it depended. This reciprocal annoyance caused the subject to form one of the articles of the treaty of peace, signed at Paris in 1783, by which it was stipulated that the inhabitants of the United States should have liberty to take fish of every kind on such part of the coast of Newfoundland as British fishermen should use, but not to dry or cure their fish upon the island. The question of supplies from America was a long time agitated, but finally authorized by act of parliament in 1822, confining the transit of goods to British bottoms. Newfoundland has had a resident governor ever since the year 1728. Civil and justiciary courts were early established; and about the year 1750, a superior court was added. But for many years the imperfect administration of justice continued to be a subject of complaint amongst the colonists. Bills have been repeatedly passed for the purpose of placing matters upon a more satisfactory footing; and in 1832 a representative government was granted to Newfoundland, similar to that enjoyed by Nova Scotia. (R. R. R.)

NEW GALLOWAY, a small royal burgh of Scotland, in the centre of the stewartry of Kircudbright. It is pleasantly situated on the western bank of the Ken. The town is formed of a single street, stretching along the public road. The parish church is about half a mile from the town, on the north side. There is attached to the town-house a criminal and debtor's jail, surmounted by a steeple and town clock. Below the town a handsome stone bridge was erected over the river in 1822. The inhabitants are entirely supported by the retail trade arising from the demands of the population of the surrounding country. It was erected into a royal burgh in 1629. By the set or constitution which, in 1708, received the sanction of the convention of royal burghs, the town ought to be governed by a provost, two bailies, a treasurer, and fifteen councillors; but as the parliamentary constituency do not amount to that number, the council is never complete. It has no funds or property of any description, with the exception of customs and small dues, which do not amount to L.3 yearly. It returns a member to parliament along with Wigton, Stranraer, and Whithorn. The population amounts to about 500.

New Hampshire.

NEW HAMPSHIRE, one of the United States of North America, is bounded on the north by the mountainous ridges which separate Canada from the states of the union, on the east and south-east by Maine and the Atlantic Ocean, on the south by Massachusetts, and on the west by Vermont. It is situated between 42. 41. and 45. 11. of north latitude, and between 70. 40. and 72. 23. of west longitude; extending in length about 168 miles, whilst its average breadth is about fifty miles, and its area is computed at 9491 miles. On the map its shape nearly resembles a wedge inserted between the states of Maine and Vermont, and having Massachusetts for its base. New Hampshire, for its narrow extent, differs more in relative elevation than any other state of the union, and of course the extremes of temperature are in corresponding excess. The line of coast is indented with small inlets of the sea, and skirted by a narrow sandy plain. At no great distance the country swells into a mountainous region, and New Hampshire has justly been called the state of hills, and also the granite state. The highest peaks of the White Mountain range, some of them 7000 feet in height, are more elevated than any others in the United States, with the exception of the Rocky Mountains. Between the Merrimack and the Connecticut are situated many considerable mountains; the names of the principal heights being Monadnock, Sunapee, Kearsarge, Carr's Mountain, and Moosehillock. As a whole, the physiognomy of New Hampshire is bold and prominent, and, although rugged, often sublime in the highest degree. The mountains of the state are in the centre, with a zone of finely-diversified hill and dale country around, the hills consisting generally of stony and moist land, and affording excellent pasturage. There are no extensive barrens, and most of the land is capable of cultivation. Many of the valleys are beautifully green, sheltered, and fertile. The rivers in particular have rich alluvial bottoms or intervale lands, the soil, although encumbered with stones, having a considerable degree of fertility. The state originally was heavily timbered, and in the interior there are still considerable tracts of forest country. There are extensive plains of warm, light, sandy, and peculiar soil, resembling, when cleared, the poorer lands of the high western prairies, covered in their natural state with white pine, and called pine plains. Mount Washington, one of the White Mountains, often visited by travellers, Mr Hinton thus describes: "After climbing the side of the mountain for some distance, the forest trees begin to diminish in height, till, at the elevation of about four thousand feet, you come to a region of dwarfish evergreens, about the height of a man's head, which put forth numerous branches, and surround the mountain with a formidable hedge, a quarter of a mile in thickness. On emerging from this thicket, you are above all woods, at the foot of what is called the bald part of the mountain, which is very steep, and consists of a huge pile of naked rocks. After attaining the summit, the traveller is recompensed for his toil, if the sky be serene, by a most noble and extensive prospect. On the south-east there is a view of the Atlantic Ocean, the nearest part of which is sixty-five miles distant in a right line; on the south, Winnipiseogee Lake lies full in view; in the south-west is the lofty summit of Moosehillock; and far away in the horizon is the Grand Monadnoc. The barren rocks, which extend a great distance in every direction from the summit, add a melancholy cast to the grandeur of the scene. The notch or gap in the White Mountains is also frequently visited as a curiosity. It is on the west side of the mountains, near the source of Saco River. It is a deep and narrow defile, in one part only twenty-two feet wide. The mountain appears as if cloven quite to its base, perpendicularly on one side, and on the other at an angle of forty-five degrees." The Lake of Winnipiseogee, mentioned above, is the largest sheet of water in New Hampshire, being about twenty-three miles in length. It is sprinkled with numerous islands, and abounds in the finest kinds of fresh-water fish. Umbagog

New Hampshire.

Lake is situated partly in this state and partly in Maine. Squam, Ossipee, Sunnapee, and Newfound Lakes, are also large collections of water. Five of the largest rivers of New England have their sources in this state, viz. the Connecticut, Merrimack, Androscoggin, Saco, and Pascataqua. There are also a number of inferior streams; and, throughout, New Hampshire is remarkably well watered, the water being generally of the purest quality. In reference to the geological features of the state, it may be mentioned, that the high ridge of mountains which divides the waters of the Connecticut from those of the Merrimack is composed of the older primitive rocks. Granite prevails in the northern and more elevated part, and mica slate in the southern. A beautiful fine-grained granite occurs in many parts of the state, and great quantities of it are transported to Boston as a building stone. To the eastward of the great ridge, mica slate, gneiss, and greenstone, are found. Steatite or greenstone of good quality is found at Orford and Francestown, and primitive limestone abounds in several places. New Hampshire also possesses beds of iron ore of excellent quality, and copper ore has likewise been discovered. Plumbago is found at some places in large quantities, and of excellent quality. These are the principal minerals which this state produces in such quantities as to be much regarded by the inhabitants.

The climate of New Hampshire is subject to the extremes of heat and cold, and to great and sudden changes, yet it is reckoned healthy, the air being generally pure and salubrious. Winter commences in November, and continues till April, the lakes being ordinarily frozen four months in the year, during six weeks of which travelling by means of a species of sledge is quite common, both on the ice and on terra firma. The open fields are commonly cleared of snow by the end of April; but the cold weather, which commences as early as the first of September, continues till May. In all the states in this neighbourhood the autumn is a delightful season. New Hampshire is an agricultural state, and by far the greater number of the inhabitants are engaged in the cultivation of the soil. The articles principally cultivated are, wheat, rye, Indian corn, oats, barley, pulse, and flax. The quantity of live stock is considerable, consisting of horned cattle, sheep, swine, and horses. Apples are abundant, and no good husbandman considers his farm as complete without an orchard; but other kinds of fruit are not so extensively cultivated. The principal articles of export are, lumber, fish, beef, pork, horses, neat cattle, sheep, flax-seed, and pot and pearl ashes. The manufactures of New Hampshire have of late years greatly increased. In 1831 there were forty cotton mills, which manufactured during that year 29,060,500 yards of cloth, and employed 875 males and 4090 females, besides some children. There are likewise some woollen establishments, ten or twelve paper mills, a number of iron founderies, and works for preparing the ore; and glass is also manufactured. In this and in some other states, large quantities of carpeting, of an inferior quality, are made in families, but these are not noticed in the estimated amount of exports. Mr Pitkins, in his statistics of the United States (1835), observes regarding this manufacture in New Hampshire: "The agent for New Hampshire, in his return to the secretary, says that the amount of carpeting made in the counties of Rockingham, Strafford, Grafton, and Coos, mostly in families, and sold in other states, exceeds, in his opinion, the amount of foreign articles consumed." The value of the imports from December 1832 to December 1833 was 167,754 dollars; and the value of the exports for the same period was, of domestic produce, 145,355 dollars, and of foreign produce, 9903 dollars; total, 155,258 dollars; the tonnage entered being 17,126. From the same source (the American Almanac) we learn, that for the year ending the 30th of September 1835, the value of the imports was 71,514 dollars; that of the exports, of domestic produce, 75,076 dollars, and of foreign produce, 6605 dollars, total, 81,681 dollars; whilst the tonnage which entered was, 6564, and that which departed, 3996 tons. This remarkable falling off in the trade of the state we have no other means of accounting for, than by supposing that the trade in this part of the United States is becoming more and more concentrated at Boston, where goods of all kinds can be more readily disposed of; and this, we have been informed by a native of the country, is the fact. Amongst the towns where the principal manufacturing establishments are situated may be mentioned Exeter, Dover, Peterborough, Franconia, Pembroke, New Ipswich, Keene, and Durham. In 1835, there were in New Hampshire twenty-six banks, having a capital of 2,655,008 dollars, and a circulation of 1,389,970 dollars. The number of post-offices was 289, and the amount of postages for the preceding year was 23,429 dollars. There are several savings' banks and insurance offices in this state. At the commencement of the war in 1775, New Hampshire had only one newspaper; but in 1834 twenty-seven were published, besides a few other periodicals. The following table exhibits a view of the counties and county towns.

Counties.	Population in 1820.	Population in 1830.	County Towns.	Population.	Distance from Concord.	Distance from Washington.
Rockingham	40,526	44,452	Portsmouth	8082	45	491
			Exeter	2759	39	474
Strafford	51,415	58,916	Dover	5449	40	490
			Gilmanton	3816	20	500
			Gilford	1872	30	504
			Rochester	2155	40	500
Merrimack	32,743	34,619	Concord	3727	...	474
Hillsborough	35,781	37,762	Amherst	1657	30	448
Cheshire	26,753	27,016	Keene	2374	55	431
Sullivan	18,628	19,687	Newport	1913	40	467
Grafton	32,989	38,691	Haverhill	2153	67	509
			Plymouth	1175	40	515
Coos	5,151	8,390	Lancaster	1187	116	558
Total	243,986	269,533				

Portsmouth, the largest town, and the only seaport in the state, is situated on the south side of Piscataqua River, three miles from its junction with the sea, in latitude 43. 4. north, and longitude 70. 45. west. The harbour is considered as excellent, having sufficient depth of water for vessels of any size, being easy of access, protected from every wind, and, owing to the rapidity of the tide, never frozen. It is so well fortified by nature, that it can be made secure against any attack, with little trouble or expense. Several forts have been planted upon commanding positions. A lighthouse on Great Island indicates the entrance, and the largest ships can come close up to the wharfs. Portsmouth is well provided with houses of public worship, and contains a custom-house, an insurance office, and several banks. This town enjoys considerable trade; but as a great portion of that from the interior of the state centres at Boston, and a part at Portland, its commerce is not so extensive or flourishing as it would otherwise be, and, as has already been shown, it is on the decline. In Navy Island, on the Piscataqua, opposite to Portsmouth, there is a navy yard of the United States. The island belongs to the general government, and is convenient for building ships of war, being well furnished for this purpose. Portsmouth has suffered much from fires at different periods, the places of the buildings destroyed being supplied by brick edifices. A very handsome bridge across the Piscataqua connects it with the state of Maine. This town was settled in 1623, and incorporated by charter in 1633.

Concord, the capital of New Hampshire, and the seat of government, is situated on both sides of the river Merrimack, in latitude 43. 12. north, and longitude 71. 29. west. The principal portion of the town is exceedingly pleasant, extending along the western bank of the river for nearly two miles. It contains a state-house, a state-prison, a court-house, several places of public worship, and above two hundred dwelling-houses. Two bridges connect the chief village with that on the opposite bank, and much of the trade of the upper country centres here; whilst the importance of the town is increased by the boat navigation which has been opened between this place and Boston by means of the Merrimack River and Middlesex Canal. The town of Concord issues three or four gazettes, and is altogether a place of large and growing business. Exeter is a handsome village, fifteen miles south-west of Portsmouth; it is situated at the head of tide-water on the Exeter River, and small vessels ascend to it. This village contains a number of public buildings, with three or four churches, and is the seat of very considerable manufactures. Philips' Exeter Academy, in this place, is one of the most ancient, opulent, and useful institutions in the United States, having many of the advantages and endowments of a college. Dover is a large manufacturing village, situated on the western bank of the Piscataqua, twelve miles north-west of Portsmouth, and through it flows the Cochecho. This river has several falls, the largest of which, being upwards of forty feet perpendicular, is at the centre of the town, and affords water-power equal to any in New England. Large iron and cotton manufactories have been erected upon these falls, and upon others a few miles higher up the river. Dover contains a number of good public buildings, has a considerable share of shipping, and is one of the most flourishing towns in the state. The greatest part of the timber exported from New Hampshire is brought to this place. Keene is a pleasant town, in the south-west part of the state, on the Ashuelot. The principal towns on the Connecticut River are Walpole, thirteen miles north-west of Keene; Charlestown, twelve miles north of Walpole; Hanover, the seat of Dartmouth College; Haverhill, twenty-seven miles north of Hanover; and Bath, adjoining Haverhill, at the head of the boat navigation. There are, besides, numerous thriving and beautiful villages. The common schools are well supported, and flourishing academies are established in many of the towns. Dartmouth College, at Hanover, was founded in 1770, and ranks as the third literary institution in New England. In 1836 there were connected with it ten instructors, 1858 alumni, 512 ministers, and 186 students, with 6000 volumes in the college libraries, and 8500 volumes in the students' libraries. The funds of this institution are considerable, the annual income being above 4000 dollars. It has likewise a medical school of deserved reputation at Hanover, where there are three professors and about eighty students. Philips' Exeter Academy, at Exeter, is an old and flourishing institution. It has funds amounting to about 80,000 dollars, a library of 700 volumes, and a handsome philosophical apparatus. Its officers are, a principal, a professor of mathematics and natural philosophy, and an assistant. The funds are appropriated in part to the support of theological students. There are a great number of less extensively-endowed academies, and the primary and other schools established throughout the state are upon the general footing of the New England system. The state has a literary fund amounting to 64,000 dollars, formed by a tax of one half per cent. upon the capital of banks. The proceeds of this fund, and also an annual income of 9000 dollars derived from a tax upon banks, are appropriated for the support of schools; and for maintaining common schools, 90,000 dollars are annually raised by a separate tax. There are in New Hampshire 159 churches for Congregationalists, and eleven associations; the Baptists have ninety churches and six associations; the Free-will Baptists have a hundred congregations; the Methodists, seventy-five ministers; the Presbyterians, ten congregations; the Christians, twenty-three congregations; the Unitarians, seventeen congregations; the Friends, fifteen societies; the Episcopalians, nine congregations; the Roman Catholics, two congregations; and the Shakers, two societies. The clergy of New Hampshire are supported by salaries, which are raised by subscription, or by voluntary taxation on property, or by contribution. The average salary of the Congregational ministers is about 400 dollars, that of the Episcopalian 600 dollars, that of the Unitarian 500 dollars, that of the Baptist 300 dollars, but those of other persuasions have still less. The inhabitants are a strong, healthy, industrious, and well-informed people; frugal, religious, and jealous of their rights. The salubrity of the climate is proved by the fact, that many instances of considerable longevity occur in the state.

As in the other states of the Union, internal improvements have within the last ten years made considerable advances in New Hampshire. Several canals have been constructed around falls in the Merrimack, viz. Bow Canal, three miles below Concord, with four locks, and passing a fall of twenty-five feet; Hooksett Canal, fifty rods long, with three locks, and a lockage of sixteen feet, passing Hooksett Falls; Amosheag Canal, with nine locks, and a lockage of forty-five feet, passing Amosheag Falls, nine miles below Hooksett Falls; Union Canal, immediately below Amosheag, overcomes seven falls in the river, and has seven locks in nine miles. A canal is now in progress around Sewall's Falls, in Concord. The Nashua and Lowel Railroad, extending from Nashua, New Hampshire, to Lowell in Massachusetts, about fifteen miles in length, was incorporated in the year 1836, and is now (1837) in progress. This railroad is expected to be continued from Nashua to Concord. The Concord Railroad Corporation has been organized.

The early history of New Hampshire will be found in the article New England. In the year 1741 a final separation took place between it and Massachusetts. A constitution was established in 1784; but in 1792 this constitution was altered and amended by a convention of delegates held at Concord, and it is that now in force. The legislative power is vested in a senate and house of representatives, which together are styled The General Court of New Hampshire. Every town or incorporated township having one hundred and fifty rateable polls may send one representa-

New Haven.

tive, and for every three hundred additional polls it is entitled to an additional representative. The senate consists of twelve members, who are chosen by the people in districts. The executive power is vested in a governor, and a council which consists of five members. The governor, council, senators, and representatives, are all elected annually by the people, their term of service commencing on the first Wednesday in June, upon which day the general court meets yearly at Concord. The right of suffrage is granted to every male inhabitant of twenty-one years of age, excepting paupers, and persons excused from paying taxes at their own request. The judiciary power is vested in a superior court and a court of common pleas. The judges are appointed by the governor and council, and hold their offices during good behaviour, but not beyond the age of seventy years. (R. R. R.)

NEW HAVEN, a city of Connecticut, one of the United States of North America. It lies round the head of a bay, which stretches inwards about four miles from Long Island Sound, seventy-six miles north-east from New York, and stands on a large and beautiful plain, which is bordered on the north partly by eminences called East and West Rock, presenting bold and almost perpendicular columns of bare trap rock from three to four hundred feet in height. Upon the eastern and western sides the city is skirted by small rivers, and extends from east to west three miles, being about two miles in width. It is regularly laid out, and consists of two parts, the old and the new town. The former was originally laid out in one large square, and is divided into several smaller squares. The central square is intersected by a very fine street, in which three handsome churches have been erected; and it also contains a new state-house, built after the model of the Parthenon, and ranking with the best American buildings. The public square and the principal streets are ornamented with trees; and a great part of the dwelling-houses have gardens filled with fruit trees, which give to the city a rural and delightful appearance. New Haven contains eight or nine places of public worship, Congregationalists and Episcopalians being the most numerous sects. There is a jail, an almshouse, a custom-house, a museum, two banks, two insurance offices, an institution for popular lectures, and a number of printing offices, from which five or six newspapers and a few other periodicals are issued. Yale College consists of ten buildings; four halls one hundred feet by forty, and four stories in height, containing thirty-two rooms each for students, a chapel, a medical college, a laboratory, and other necessary apartments. According to the American Almanac for 1837, the state of this institution was as follows:—Instructors, twenty-seven; alumni, 4485; ministers, 1297; students, 413; volumes in the college libraries, 10,500; and volumes in the students' libraries, 15,000. The philosophical and chemical apparatus are good, and the cabinet of minerals is the most valuable in the United States. In connection with this establishment there are theological, medical, and law schools; and the place is celebrated for the number of its boarding schools, there being seldom fewer than one thousand persons who come hither from abroad for the purpose of education. The harbour of New Haven is well defended from winds, but is shallow, and gradually filling up with mud; an evil which has been remedied in part by the construction of a wharf, about a mile in length, extending into the harbour. The maritime commerce of this city is greater than that of any other place in Connecticut, and it owns a considerable amount of shipping. Both the foreign and the coasting trade are extensive, and packets and steam-boats ply regularly between New Haven and New York. It was first settled by the English in the year 1638, and, as the capital of the colony of New Haven, continued distinct from that of Connecticut till the year 1665. The legislature of the state meets alternately here and at Hartford. The population in 1820 amounted to 7147, in 1830 to 10,678, and in 1837 to about 13,000. Long. 72. 57. W. Lat. 41. 18. N.

Newhaven || New London.

NEWHAVEN, a town of the county of Sussex, and the hundred of Holmstrough, sixty miles distant from London. It stands at the mouth of the river Ouse, and is the port of Lewes, where the custom-house is established. It was formerly a place of more importance than at present; but the harbour has been neglected, and nearly choked up by sand. It is sometimes called Meeching. The population amounted in 1801 to 584, in 1811 to 755, in 1821 to 927, and in 1831 to 904.

NEWHAVEN, an ancient and considerable fishing village, situated on the Frith of Forth, less than two miles north from Edinburgh, and one mile west from Leith. The village is formed by a street running contiguous with the shore, with several back lanes, and in appearance it has nothing to recommend it to attention. It possesses a low-water pier, which affords shelter to the fishing boats of the station, and accommodation to the ferry and other steamers in the taking up and landing of their passengers and goods. A handsome chapel has lately been erected at the west end of the village, and forms a subsidiary place of worship, or chapel of ease, to North Leith church. The inhabitants are a most industrious race, both sexes being busily employed, the men in procuring the fish, and the females in carrying them to the market. The oyster-bank is valuable, and yields fish of excellent quality. Were it turned to its proper account, it would yield a far greater amount of revenue to the proprietors. At the west end of the village there has been erected within these few years a considerable suburb, called Trinity, consisting chiefly of houses built in the villa style, and cottages for sea-bathing quarters. There is a chain-pier here, built by Captain Brown, from which steamers for various quarters hourly depart. A bill passed last session (1836–37) for constructing a harbour here, in order to accommodate the large class of steamers plying between the English and Scotch capitals. At Granton, about a mile farther west, a harbour is considerably advanced for the same purpose. There is no municipal government in Newhaven, the superiors of the place being the town-council of Edinburgh, who purchased it in the year 1511, with all the privileges and rights with which James IV. had endowed it. Along with Leith, Portobello, Musselburgh, and Fisherrow, it returns a member to Parliament.

NEW HOLLAND. See AUSTRALASIA.

NEWINGTON, a parish of the county of Surrey, in the hundred of Brixton. It is nearly adjacent to London, or rather to Southwark, and by the reform act contributes to the election of two members of parliament along with Lambeth and Camberwell. It is frequently called Newington-Butts, from having formerly been the place where the citizens of London practised archery. The population amounted in 1801 to 14,847, in 1811 to 23,853, in 1821 to 33,047, and in 1831 to 44,526.

NEWINGTON-STOKE, a parish in the county of Middlesex, and hundred of Ossulton, two miles and a half from London, on the road from Shoreditch. The population amounted in 1801 to 1462, in 1811 to 2149, in 1821 to 2670, and in 1831 to 3480.

NEW LONDON, a city and port of entry in Connecticut, North America, situated on the western bank of the river Thames, about three miles from its mouth. The town is irregularly laid out, but has convenient public buildings, and several churches for various denominations of Christians. The harbour is the best in the state. It is defended by Fort Trumbull on the western side of the river, and by Fort Griswold on the eastern side, in Groton. A lighthouse has been erected upon a point which projects considerably into the Sound. The commerce is extensive, Newport || Newspapers.

and packets and steam-boats ply regularly between this port and New York. The population in 1836 was about 6000. Long. 72. 9. W. Lat. 41. 22. N.

NEWMILLS, a considerable burgh of barony, situated on the right bank of the river Irvine, in the parish of Loudon, Ayrshire. It was erected by royal charter in 1490. The inhabitants are generally weavers. There are about 140 burgesses, who pay a small sum at admission, which is applied in keeping the streets in repair. The whole income of the burgh consists in the customs, public green, and feu-duties, which in all do not yield L.10 per annum. In the town there is the parish church, and a meeting-house belonging to the United Secession body. A good market is held weekly, and five annual fairs may likewise be held. The burgh is governed by two bailies, a chancellor, treasurer, twelve councillors, and a town-clerk. The population in 1821 amounted to 1543, and in 1831 to 1650.

NEW ORLEANS. See the article Louisiana.

NEWPORT, a small town, or rather village, of Cornwall, in the parish of St Stephen, near to Launceston, which had long the privilege of sending two members to the House of Commons; but it has been disfranchised. The parish in which it stands contains 1084 inhabitants, few of whom live within the limits of the borough.

Newport, a market-town of the county of Salop, in the hundred of South Bradford, 140 miles from London. It is situated upon a plain on the borders of Staffordshire, and has a market, which is held on Saturday. The population amounted in 1801 to 2307, in 1811 to 2114, in 1821 to 2343, and in 1831 to 2745.

Newport, a town of the county of Pembroke, in the hundred of Kemmess, in South Wales, distant 244 miles from London. It is situated on the river Nevern, which is navigable, and runs into the Bristol Channel. It is a corporate town, governed by a mayor, twelve aldermen, and a recorder; but the market, having long declined, has at length disappeared. The population amounted in 1801 to 1392, in 1811 to 1433, in 1821 to 1666, and in 1831 to 1798.

Newport, a market-town of the county of Monmouth, and hundred of Wentlodge, 147 miles from London. It stands at the mouth of the river Usk, across which there is a fine bridge. A canal, divided into two branches, and running into great coal-fields, has created a large trade in coals between this town and the opposite ports of the Bristol Channel in the counties of Somerset and Devon. In the neighbourhood there are many ruins of ancient castles and of religious houses. The market is held on Saturday. The population amounted in 1801 to 1135, in 1811 to 2346, in 1821 to 4001, and in 1831 to 5441.

Newport, a town situated within the parish of Carisbrook, in the Isle of Wight, and the capital of that island. It is seventy-nine miles from London, and stands upon a gentle elevation close to the river Medina. It is a well-built town, with a good market-place, wide streets, and respectable dwellings. It has a corporation, consisting of a mayor, twelve aldermen, and twelve burgesses, in whom was formerly vested the right of electing two members to the House of Commons; but this is now extended to all the inhabitants. There are good markets, which are held on Wednesday and Saturday, and at the latter the greater part of the corn grown on the island is sold. About one mile from the town is Carisbrook Castle, a remarkable pile, celebrated for the imprisonment of Charles I. within its walls. It is still in tolerable preservation. The population amounted in 1801 to 3585, in 1811 to 3855, in 1821 to 4059, and in 1831 to 4081.

Newport. See the article Rhode Island.

Newport-Pagnell, a town of the county of Buckingham, in the hundred of the same name, fifty-one miles distant from London. It stands on the river Ouse, where the water of the small river Lovett falls into that stream. The church, situated upon an elevation, is an ancient and magnificent building; and near it there are several alms-houses endowed by a citizen of London. Considerable occupation is afforded in making bone lace, and there are paper-mills. It was long the residence of the poet Cowper. There are markets, which are held on Wednesday and on Saturday. The population amounted in 1801 to 2048, in 1811 to 2515, in 1821 to 3103, and in 1831 to 3385.

New Ross || Newspapers.

NEW ROSS (anciently Roseponte) is not, as its name might import, a new town, but one of considerable antiquity, and is called new only to distinguish it from an older place in the neighbourhood, also called Ross, but now of no importance. New Ross is denominated an ancient borough in the charter which was granted to it by James I. It is situated on the left bank of the river Barron, in the county of Wexford, at the distance of eighty-six statute miles from Dublin. The river is navigable up to the town for vessels of 200 tons burden. On the banks are extensive quays and lofty warehouses. A wooden bridge over the Barron connects the town with the county of Kilkenny. A thriving export trade is carried on in agricultural produce, and the commerce of the town is increasing, and likely to increase considerably. Great advantages are expected to accrue from the port having been opened by the lords of the treasury for the importation and bonding of customable goods; and a communication is contemplated with Kilkenny by means of inland navigation. The place was formerly enclosed by walls, and regularly fortified, yet it made but a feeble resistance to the army of Cromwell. In 1798, an obstinate and bloody conflict ensued here between the king's troops and the insurgents. The borough of New Ross returns one member to parliament. In 1831 the population stood thus: Males, 2173; females, 2838; total, 5011. The families chiefly employed in agriculture were eighteen; in trade, manufactures, and handicraft, 532; not comprised in the two preceding classes, 578; total, 1128.

NEWSPAPERS are publications issued in numbers, consisting generally of single sheets, which, appearing at short and regular intervals, convey intelligence of passing events, and at the same time advocate certain principles in politics, literature, and religion, but chiefly in the first of these departments.

The nature and practical utility of newspapers.

One of the most remarkable characteristics of modern, as compared with ancient times, is the periodical press, an engine affecting society in all its relations, and forming one of the most important safeguards of public liberty. Under this head are usually included reviews, magazines, and other publications of a similar kind, as well as newspapers. But although, upon certain grave and important questions, the former sort of periodicals may contribute more to enlighten the public mind, and to guide public opinion into safe and proper channels; yet the wide diffusion of newspapers, their rapid communication of intelligence on subjects of immediate interest, their hasty and rough but often vigorous comments on the leading events of the day, and the means which they thus afford of acting immediately and constantly upon the public mind, in all its varied states, render them much more powerful as instruments of political influence, and thus secure to them a prominence to which, intrinsically, they are by no means entitled. They circulate every kind of information with equal celerity and regularity; they bring to every man's home and fireside intelligence of all that is passing in the great world, whether at home or abroad, in war, in politics, in government, in commerce, and in the common affairs of life; they are registers of extraordinary events, as well as of ordinary occurrences, of discoveries and inventions, as well as accidents, offences, calamities, or crimes; they often diversify their contents with scienti-

Newspapers.

fic and literary notices; and from the variety of facts and information which they contain, they are indispensable to many classes of society, and more or less agreeable or instructive to all. To persons engaged in mercantile transactions they are peculiarly important, inasmuch as, from the advertisements they circulate, and the details they furnish respecting the supply and demand of commodities in all parts of the world, with the prices and the regulations by which these are affected, newspapers supersede a great mass of epistolary correspondence; place merchants in remote situations upon an equality, in point of information, with those frequenting the principal marts; and wonderfully quicken all the movements of commerce. Besides, these publications have themselves become a considerable article of commerce, in the production of which skill, talents, and capital are equally requisite.

Historical notices of their origin and progress.

An historical account of newspapers, and of periodical publications in general, is still a desideratum in literature; nor can it be doubted, that if the task were undertaken by an individual of competent ability, and executed with the requisite care and research, the result would be a work of the greatest interest and importance. From the researches of Mr Chalmers, it appears that to the state of Venice belongs the honour of having produced the first *gazetta* or newspaper, which appeared as early as the year 1536. The war which the republic of Venice then waged against Suleiman II. in Dalmatia, appears to have given rise to the custom in that state of communicating both military and commercial information in written sheets (*notizie scritte*), which were read at a particular place by those desirous of learning the news, and who paid for this privilege in a coin that is no longer in use, called *gazetta*. From this circumstance, it would seem, the name was, in course of time, transferred to the newspaper itself, not only in Italy and France, but at length also in England and in other countries.[1] The first of these *notizie* or gazettes was a monthly paper, circulated, or rather read, at Venice. The jealousy of the government prevented its being printed; and the *gazetta* continued to be distributed in manuscript till towards the close of the sixteenth century. In the Magliabecchi library at Florence there are still preserved thirty volumes of these *gazettas*, all of them in manuscript. Those who first wrote newspapers in Italy were commonly called *menanti*, because, according to Vossius, they intended, by these loose papers or sybilline leaves, to spread about defamatory reflections; and for this reason all such gazettes were prohibited by Gregory XIII. in a bull entitled *Minantes*, from the Latin *minari*, to threaten. But Ménage, with more probability, derives the name from the Italian verb *menare*, which signifies to lead, direct, or produce.

The first English newspaper appeared in the reign of Queen Elizabeth, during the alarm occasioned by the approach of the Spanish Armada to our shores. In the British Museum, there are several copies which were printed in 1558, whilst the Spanish fleet was in the English Channel; in order that, during a moment of general anxiety, the circulation of false reports might be prevented by publishing real information. This newspaper is entitled *The English Mercurie*, which, by authority, "was imprinted at London, by Christopher Barker, her highnesses printer, 1583." Burleigh's newspapers, however, were all extraordinary gazettes, not regular journals, and they were published from time to time, according as that skilful statesman desired to soothe, inform, or exasperate the people. Periodical papers appear to have first come into general use during the civil wars in the reign of Charles I., and in the time of the commonwealth; in fact, each party had their newspapers, to disseminate sentiments of loyalty, or to foster a spirit of resistance against the inroads of power. The country was accordingly overflowed with tracts of every size, and of various denominations, many of them written with great ability, and displaying uncommon courage. *Mercury*, however, was the prevailing title, although generally qualified with some epithet; and the quaintness peculiar to the age is curiously exemplified in the names of some of the "news-books," as the Dutch Spye, the Scots Dove, the Parliament Kite, the Secret Owle, Heraclitus Ridens, the Parliament Vulture, the Parliament's Screech Owle, the Loyal Scout, and so forth. A catalogue of the different Mercuries would exhibit a curious picture of those singular times. Mercurius Acheronticus brought hebdomadal tidings from the infernal regions; Mercurius Democritus communicated marvellous intelligence from the world in the Moon; the Laughing Mercury gave exact information of proceedings at the antipodes; and the Mercurius Mastix lashed unmercifully all other Mercuries, Scouts, Posts, Spies, Discoverers, and Intelligencers. The Restoration and the Revolution occasioned each the establishment of a number of newspapers in England, all of which have long since disappeared; nor was it until the reign of Queen Anne that London could boast of a daily paper. The first of the class published in Great Britain was the Daily Courant, which for a considerable time occupied the field alone; but at length two rivals appeared in the Daily Post and the Daily Journal, and, in 1724, we find that these three papers were simultaneously published. Little change seems to have taken place during the reign of George I.; but in that of George II. every kind of periodical publication increased abundantly. The number of newspapers annually sold in England, according to an average of three years ending with 1753, was 7,411,757; in 1760 it amounted to 9,464,790; in 1767 it rose to 11,300,980; in 1790 it was as high as 14,035,636, and in 1792 it amounted to 15,005,760.

The victorious arms of Cromwell communicated to Scotland the first newspaper. It appeared at Leith in October 1653, under the title of *Mercurius Politicus*, but, in November 1654, was transferred to Edinburgh, where it continued to be published until the 11th of April 1660, when it came out under the name of *Mercurius Publicus*. This paper was a reprint, for the information of the English soldiers, of a London publication, entitled a Diurnal of some Passages and Affairs. But a newspaper of native manufacture soon made its appearance, under the title of *Mercurius Caledonius*. The first number of this journal was published at Edinburgh on the 31st of December 1660, "comprising," as its title bears, "the affairs in agitation in Scotland, with a summary of foreign intelligence." The publication, however, extended only to ten numbers, which, as Chalmers says, "were very loyal, very illiterate, and very affected." Even after the Restoration the newspapers published by authority continued to be reprinted in Edinburgh, and the *Mercurius Publicus* instructed the natives until it was superseded by the Kingdom's Intelligencer. At the era of the Revolution there was not a newspaper printed in Scotland; nor was it until after ten years had elapsed that the Edinburgh Gazette was published, in the month of February 1699, by James Watson, author of a History of Printing, who, after the publication of forty numbers, transferred it to one John Reid, whose son continued to print the paper even after the union. In February 1705, Watson established the Edinburgh Courant, which he relinquished, after the publication of fifty-five numbers; and, in September 1706,

[1] Some have thought that the word *gazetta* is derived from *gazza* or *gazzera*, a magpie, or chatterer; whilst others deduce it from the Latin *gaza*, colloquially lengthened into *gazetta*, and therefore signifying a little store or treasury of news. From the Italian the word passed into the Spanish language, which has also *gazetista*, signifying one fond of or partial to the gazette. In German, *zeitung* is formed from the ancient *theidinge* or *teidung*, identical with the English *tiding* and the Swedish *tidingar*.

he commenced the Scots Courant, which he continued to print until after the year 1718. To these papers were added, in October 1708, the Edinburgh Flying Post; in August 1709, the Scots Postman, printed for David Fearne by John Moncur; and, in March 1710, the North Tatler, printed by John Reid for Samuel Colvil. In 1715, a newspaper was for the first time attempted in Glasgow, under the title of the Glasgow Courant; but this did not prevent the establishment of other newspapers in Edinburgh. In March 1714, Robert Brown began to print the Edinburgh Gazette, or Scots Postman, twice a week; and, in December 1718, the town-council gave an exclusive privilege to James M'Ewen to publish three times a week the Edinburgh Evening Courant; upon the condition, however, that "the said James" should, before publication, "give ane coppie of his print to the magistrates." This journal still continues to be published, but whether or not the original stipulation be complied with, we are unable to say. The establishment of the Courant was followed by that of the Caledonian Mercury, the sequel of *Mercurius Caledonius*, the first number of which appeared on the 28th of April 1720. The original proprietor was a lawyer of the name of Roland, upon whose decease, in 1729, the property of the paper was transferred to Mr Thomas Ruddiman, the original editor, and continued in his family until May 1772, when it was sold by the trustees of his grandchildren to John Robertson, an opulent typographer, along with the printing-house and printing materials. From the commencement, the Caledonian Mercury, like the Courant, has been published three times a week.

London newspapers.

Having given this slight sketch of the origin and progress of newspapers, we now proceed to consider the actual state and condition of this portion of the press amongst ourselves; and here our attention is naturally directed, in the first instance, to the metropolitan journals, which are pre-eminent for the amount and variety of matter they contain, the rapidity with which they are printed and circulated, and the fulness and accuracy of their reports. The establishment of a first-rate London paper is the most complete of the kind in existence. Its activity is immense, extending not only to all that is important at home, but to every thing that is particularly interesting abroad. In 1826, when Mr Canning sent a body of troops to Portugal, in compliance with a demand made by the government of that country, reporters belonging to several London journals accompanied the expedition; and since the commencement of the civil war in Spain, the head-quarters of Don Carlos, and those of the Christino generals, have respectively been frequented by emissaries of the leading morning papers. Reports of the proceedings in the Spanish Cortes, and the discussions in the French Chamber of Deputies, have on particular occasions accompanied those of the debates in the British houses of parliament. Indeed there is almost nothing beyond the reach of their enterprise and activity.

Employed upon each morning paper of the first class there are an editor and sub-editor; from ten to twelve, or even fourteen, regular reporters, at salaries of from four to six guineas each per week; from thirty to thirty-five compositors in the printing-office; several readers, who correct the proofs as they come from the compositors; a certain number of men and boys to attend to the printing machine, and take off the papers as they fall from the cylinders; a publisher and sub-publisher, besides a number of clerks in the office to receive advertisements and keep the accounts, with various other individuals engaged in the performance of subordinate duties. The salary of an editor varies from L.600 to L.1000 per annum, and that of a sub-editor from L.400 to L.600. The largest item in the expenditure of a morning paper is that charged under the head of reporting, which generally amounts to upwards of L.3000 per annum. In fact, the salaries paid weekly to editors, reporters, and others upon the establishment, do not fall short of L.180; and if to this be added the expense of occasional reporting, the cost of foreign newspapers and private correspondence, the sums paid for expresses, and various other items which it is unnecessary to enumerate, the total weekly expenditure can scarcely be estimated under L.250, or L.13,000 per annum. The duty of the principal editor commences with the publication of the evening papers, the leading articles of which he has to read, that, if necessary, he may refute or support their statements and arguments. He generally remains at his post until a late hour, prepared to write comments on the foreign journals as they arrive (a duty in which he is generally assisted by the subeditor), and also to direct attention, in a leading article, to any topic of public interest. During the sitting of parliament, he is frequently obliged to remain at the office of the paper until two or three o'clock in the morning; and such is the energy with which the metropolitan press is directed, that it is not uncommon to see a leading article of nearly a column in length written on a subject which had been debated in the House of Commons until a late hour in the morning. The promptitude of execution which this presupposes is wonderful, and can only be the effect of habit invigorated by the impulses peculiar to the occasion.

But perhaps the most extraordinary part of the machinery of a morning paper is the reporting. The establishment of reporters varies, as already stated, from ten to fourteen; and most of the persons so engaged are gentlemen of education, sometimes students of law, remarkable for their activity and intelligence. During the session of parliament, the reporters of the leading papers attend by turns each day, from the time the business commences, one succeeding the other, according to previous arrangement, and each remaining in the house for half or three quarters of an hour. If the debate be not protracted, or "heavy," as it is called, the reporter in the House of Commons, when relieved, enters a small apartment at the end of the lobby, appropriated exclusively for the purpose, and there arranges his notes, which are seldom taken in short-hand, from the impossibility, in ordinary cases, of finding room in a newspaper for all that a member may say, or even the half of it. He then proceeds at once to the office of the paper on which he is engaged, and by him the attention of the editor is directed to any thing of commanding interest which may have transpired. His slips, as they are written, are handed by the printer to the compositors, whose number during the session of parliament is generally increased; and as one reporter follows another, it is not unusual for a debate which has terminated at midnight to be set up in types, and ready for printing, by two o'clock in the morning. On nights of prolonged discussion, when the houses sit late, some of the reporters, particularly those whose previous task may have proved least onerous, are required to return to the gallery, and take what is called "a double turn." In general, however, owing to the subdivision of labour, the duty of an individual reporter is by no means burdensome, and requires promptitude and facility rather than prolonged exertion. The expertness produced by habit is remarkable, and it not unfrequently happens that a single reporter, from the notes taken in three quarters of an hour, supplies from one to three columns of printed matter to the paper on which he is engaged. Besides the corps of regular reporters attached to a newspaper, there are several occasional ones, called "penny-a-line men," from the circumstance of their furnishing articles of intelligence at a fixed price per line. The reporters of this class are to the body of the press what the Cossacks are to a disciplined army; a species of active but irregular troops, who forage for news in all directions, pick up every scrap that comes in their way, and having dressed it up in their best style, straightway offer it for sale at the newspaper offices.

Newspapers.

In obtaining intelligence by express, and also in forwarding it in this manner, some of the evening papers have latterly made great exertions. The Courier and the Sun have sometimes published the speech of the king of the French twenty-six or twenty-seven hours after it had been obtained by their agents at Paris; and the latter journal has, on many occasions, forwarded "express editions" to all parts of the country, containing the conclusion of an important debate which terminated several hours after the departure of the mail, and thus anticipating by a day the ordinary course of publication.

Newspapers, in London, are, for the most part, sold to newsmen or news-venders, by whom they are distributed to the purchasers both in town and country. The newsmen, therefore, are the retailers, and for the business of distribution they receive a certain regulated allowance, amounting to two shillings and threepence upon a *quire* (as it is called) of twenty-seven papers. Some of the clerks at the post-office, called clerks of the roads, are likewise considerable news-agents. The stamp-duty charged upon each newspaper was formerly fourpence, with a discount, however, of twenty per cent. on such as were sold at a price not exceeding sevenpence, which reduced the stamp-duty actually paid to threepence and one fifth. But, by the act 6 and 7 William IV. c. 76, this duty has been repealed, and the following duties are now imposed in its stead:

For every sheet, or other piece of paper, whereon any newspaper shall be printed, one penny. But where such sheet or piece of paper shall contain on one side a superficies, exclusive of the margin of the letter-press, exceeding 1530 inches, and not exceeding 2295, the additional duty of one halfpenny is charged; and where the same shall contain on one side a superficies, exclusive of margin, exceeding 2295 inches, a further duty of one penny; provided always that any sheet or piece of paper containing on one side a superficies, exclusive of the margin of the letter-press, not exceeding 765 inches, which shall be published with and as a supplement to any newspaper chargeable with any of the foresaid duties, shall in that case be charged only with the duty of one halfpenny. Then follow definitions of what are to be deemed and taken to be newspapers chargeable with these duties. These are, 1st, Any paper containing public news, intelligence, or occurrences, printed in any part of the united kingdom, to be dispersed and made public; 2dly, any paper printed in any part of the united kingdom weekly or oftener, or at intervals not exceeding twenty-six days, containing only or principally advertisements; and, 3dly, any paper containing any public news, intelligence, or occurrences, or any remarks or observations thereon, printed in any part of the united kingdom, for sale, and published periodically, or in parts or numbers, at intervals not exceeding twenty-six days between the publication of any two such papers, parts, or numbers, where any of the said papers, parts, or numbers shall not exceed two sheets of the specified dimensions, exclusive of any cover or blank leaf, or shall be published for sale for a less sum than sixpence, exclusive of the duty imposed by the act. With reference to this last description of newspapers, it is provided, that no quantity of paper less than a quantity equal to twenty-one inches in length by seventeen inches in breadth, in whatever way or form the same may be made or divided into leaves, or in whatever way the same may be printed, shall, with reference to any such paper, part, or number, as has been above described, be deemed or taken to be a sheet. And it is also generally provided, that any of the several papers before described shall be liable to the duties imposed by the act, in whatever way or form they may be printed or folded, or divided into leaves or stitched, and whether the same shall be folded, divided, or stitched, or not. The *exemptions* are, the Police Gazette or Hue and Cry; daily accounts or bills of goods imported and exported; warrants or certificates for the delivery of goods, and the weekly bills of mortality; and also papers containing lists of prices current, the state of the markets, accounts of the arrival, sailing, or other circumstances relating to merchant ships or vessels, and generally any other matter wholly of a commercial nature; provided such bills, lists, or accounts do not contain any other matter than that which has usually been comprised in them.

The *regulations* prescribed by this act are the following, viz. A discount of twenty-five per cent. on the above duties is allowed to newspapers printed in Ireland. To prevent fraud in the returns as to newspapers, it is enacted that, from the 31st of December 1836, a separate or distinctive stamp or die must be employed for each paper. No person can print or publish a newspaper until after a declaration has been made and lodged at the stamp-office, containing certain particulars specified in the act as to the names and addresses of the printer and certain of the proprietors, &c. of such paper, under a penalty of fifty pounds; and persons wilfully making a false or defective declaration are, upon conviction, to be deemed guilty of a misdemeanour. There are also a number of regulations intended to provide for the discovery and liability of the printer and proprietors, the security of the duties, and the prevention of the sale of unstamped papers. Any person publishing, selling, or disposing of newspapers not duly stamped, is subjected to a penalty of twenty pounds; and it is declared to be lawful for any officer of stamps, or any person authorized by the commissioners for that purpose, to seize any such offender, and take him before any justice having jurisdiction where the offence is committed, who shall summarily determine the matter, and, in default of payment upon conviction, commit such offender to prison for some term not exceeding three calendar months, nor less than one. The penalty for sending abroad newspapers not duly stamped is L.50. Justices may grant warrants to search for unstamped newspapers, to seize presses, &c. used in printing them; on admittance being refused, officers and others may enter forcibly; and persons offering resistance to officers in the discharge of their duty incur a penalty of twenty pounds.

Such are the provisions, exemptions, and regulations of the act 6 and 7 William IV. c. 76. The duty, which formerly amounted (deducting the discount) to threepence one fifth, being thus reduced to one penny, the price of the great majority of the London papers has in consequence been lowered from sevenpence to fivepence; but provincial papers, which are got up at comparatively little expense, are now generally sold for fourpence halfpenny or fourpence; and this is also the case with one or two of the metropolitan journals. The reduction of the price occasioned a considerable increase in the demand for the established journals; and, since the reduction of the duty, a considerable number of new weekly papers also started into existence, both in the metropolis and throughout the country; but hitherto no new daily paper has been established, and several of the weekly prints have already disappeared. Supposing it to have been expedient to reduce the duty, and to fix it at an uniform amount upon all papers, the arrangements prescribed in the act 6 and 7 William IV. are perhaps as unexceptionable as any that could be devised; but some persons are of opinion that it might have been better to assess the duty upon an *ad valorem* principle, making it in every case a certain aliquot part of the price.

The returns of the London journals arise from two sources; the profits on the circulation, and those derived from advertisements. Each paper being now sold to the newsman at fourpence, the sum received by the proprietor for paper, printing, and the expense of his establishment, is threepence, or one halfpenny more than under the former law. Advertisements form a considerable source of profit to newspapers; indeed, without this, some of the most widely circulated of their number could not support the great expenditure necessary for carrying them on. Each advertisement published in Great Britain is now charged with a duty of one shilling and sixpence, without distinction of length; but until the year 1833 the duty charged was three shillings and sixpence. In 1832, the advertisements produced L.155,400 in Great Britain, and L.15,249 in Ireland, at least three fourths of which were derived from newspapers.

The following table has been constructed from detailed returns showing the number of stamps issued to each newspaper in Great Britain and Ireland, with the number of advertisements published, and the amount of advertisement duty paid, by each paper during the first six months of the year 1837. The duty is charged at one shilling and sixpence upon each advertisement published in Great Britain, and at one shilling upon each advertisement published in Ireland.

	Number of Papers.	Number of Stamps.	Number of Advertisements.	Amount of Advertisement Duty.		
				L.	s.	d.
London Papers	93	15,100,197	292,033	21,902	9	6
English Provincial Papers	217	7,290,452	317,474	23,810	11	0
Welsh Papers	10	190,955	6,499	487	6	6
Edinburgh Papers	13	768,071	20,579	1,543	9	6
Scotch Provincial Papers	46	1,121,658	45,371	3,402	16	8
Dublin Papers	21	1,493,838	45,848	2,292	8	0
Irish Provincial Papers	60	1,049,358	41,284	2,064	4	0
Total in Great Britain and Ireland	460	27,014,529	769,088	55,503	5	2

In 1832, when the government duty was charged at three shillings and sixpence upon each advertisement, the produce of this branch of the revenue in Great Britain and Ireland amounted to L.170,649. The portion of this sum derived from newspapers, as distinguished from other periodical publications, has not been stated; but it may fairly be taken at not less than three fourths of the whole, or L.127,986. From the above table, however, it appears that the newspaper advertisement duty, for the first six months of 1837, amounted to L.55,503s. 5s. 2d. which, for the whole year, would give a return from this source alone of L.111,006. 10s. 4d. But in 1833 the duty was reduced to one shilling and sixpence in Great Britain, and one shilling in Ireland, at which rates it is now charged upon advertisements in each country respectively; yet notwithstanding this reduction, it appears that, if the second half of 1837 equal the first, the total produce of that year, arising from advertisements, will fall short of the total produce of 1832, the year before the duty was reduced, by only L.16,980.

French newspapers.

Newspapers were of later origin in France than in England. The earliest notice we have of any publication of this kind is that contained in Saint Foix's curious *Essai Historique sur Paris*, where it is stated that Renaudot, a physician of Paris, sought to amuse his patients by collecting and circulating news, and thus greatly increased his practice. As the seasons were not always sickly, and the doctor had a taste for newsmongering, he considered that he might turn both his time and his talents to account by giving weekly to his patients some fugitive sheets containing the news of various countries; and for this he obtained a privilege in 1632. But there was really no political press in France until the year 1789, when the Constituent Assembly, in the declaration of rights, decreed (5th October) that the free communication of thoughts and opinions is one of the most precious rights of man, and that every citizen may therefore speak, write, and print freely, "sauf à répondre de l'abus de cette liberté dans le cas déterminé par la loi." This decree, which formally recognised the liberty of the press, at the same time called it into existence. But no distinction was made between the various modes of publication, and no greater securities were required for newspapers than for books and pamphlets. The periodical press was a stranger to the habits of the country, and the public were not prepared for it. Violent and witty pamphlets were indeed written, but no one had yet learned either to write or to read a journal. In this respect the *Moniteur*, an official paper, began the education of the community in France. No journals were previously known, except the *Mercure*, the *Gazette de France*, and the *Courrier de Provence*, which had been the depository of Mirabeau's harangues, before the opportunity had arrived for launching them in the National Assembly. As the passions of men became heated, a new brood was hatched, amongst which Marat's *Ami du Peuple*, and Hébert's *Père Duchesne*, enjoyed a bad pre-eminence. The rapidity and acerbity of the pamphlets of the time were suited to the taste of a people which lived upon excitement. But still a journalist was, in fact, an individual who united and confounded all the branches of the work in his own person; it was Marat, or Hébert, or Camille-Desmoulins. Violent alternations of license and despotism distinguished the most stormy period of the Revolution; yet, in spite of the extravagance of the one, and the disproportionate severity of the other, the press continued to make way. Under the consulate and the empire it was subjected to systematic control. No journal could appear without the authority of the minister of the interior; the number of provincial papers was limited to one for each department, and these were placed under the authority of the prefects. On some occasions, however, Napoleon himself became a journalist, and replied in the *Moniteur* to the manifestoes of the British government. He also encouraged a revival of religious doctrines, the influence of which was felt in literature before it reached the sphere of politics. Of this school the *Journal des Débats* was the centre, and Chateaubriand and Bonald were the organs. Things proceeded in this way till after the disastrous campaign of Moscow, when the liberty of writing and speaking began to be once more asserted, and public opinion was ardently supported by the rising generation; so that, upon the whole, when the French empire was broken up, the press had in some measure taken root in the habits of the country, and the demand for newspapers had become general. Even whilst the expression of opinion was checked, the means of publicity were established and increased. The *Moniteur*, the *Bulletin des Loix*, and the *Journal de la Librairie*, awakened attention to the public interests; each department had a paper of its own; and

Newspapers.

Paris had already several journals, particularly the *Gazette*, the *Journal de Paris*, the *Quotidienne*, and the *Journal des Débats*, which, under the title of *Journal de l'Empire*, had as many as 20,000 subscribers. Literary criticism was installed in the daily papers, and gave birth to the *Feuileton*, to which the pens of Dussault and Geoffroy imparted that sharp and sparkling vivacity which still preserves its traditional charm. At first, however, it was no better treated by the government of the restoration than it had been by that of the empire. Its history during this period is filled with laws and ordinances, succeeding each other at short intervals, and marking the various turns of the conflict between the men of the past and those of the present time, the restored government, and the liberal party, as it is called. But in 1819 a law was passed which had the merit of acknowledging sound principles respecting the rights of publicity; and by another enactment, made in 1828, a sort of compromise was entered into between the rights of the press and the prejudices of the government. Since the revolution of July 1830, however, a material change has taken place. In 1819, the interest and the position of the parliamentary tribune and the press were identical; since 1830, they have become two distinct and rival powers, one or other of which must ultimately give way. In the meanwhile, the gagging enactments of the year 1835, which characterize the existing legislation, have given a decided preponderance to the tribune, and, through it, to the government.

The French journals fluctuate so greatly that they can only be described generally in connection with the events of the time. When M. de Villèle came into office, the two organs of the liberal party were the *Constitutionnel* (established in 1815), the *Courrier Français*, the *Journal du Commerce*, and the *Journal de Paris;* whilst the royalist party divided their patronage between the *Journal des Débats*, the *Gazette de France*, and the *Quotidienne.* The *Aristarque* and the *Oriflamme* were then set up by the ultra-royalists; and Villèle established the *Etoile*, an evening paper devoted to the personal defence of the minister. The *Journal des Débats* now seceded from the side of government, and brought over to the liberal party the support of that portion of the middle classes which had espoused the interests of the restored monarchy. The *Globe* and the *Producteur* led on the public to the study of science, literature, politics, political economy, and philosophy, and sowed the seeds of instruction in many minds where they have since ripened into an abundant harvest. The daily papers obtained an entire mastery over public opinion. The *Constitutionnel* and the *Journal des Débats* were really the kings of the multitude; and their slightest hint acted sympathetically upon the resolutions of the community.[1] The administration of M. de Martignac, which was a compromise with the liberal party, abolished the censorship, and reduced the securities paid in by the journals. It only gave birth to one ministerial paper. But that of M. de Polignac, which was openly hostile to the liberty of the press, elicited a new class, resolved to go all lengths, and to yield to no obstacle. Then appeared the *Universel*, a partisan of absolute power; the *Temps*, representing the *centre gauche;* the *National*, detached from the *Constitutionnel*, and conducted by M. Thiers, in the interest of the house of Orleans; and the *Globe*, which now became a daily paper. In the provinces appeared the *Tribune des Departements*, and the *Courrier des Electeurs;* but the great body of the people still clung to the old-established and well-known papers. The popularity of the *Constitutionnel*, the *Journal des Débats*, and the *Courrier Français*, increased with the danger. When the revolution of July broke out, the first of these papers had a circulation of 22,000, and the second of 18,000; and each of the twelve shares in the former journal, which were originally taken at L.200, though the money was never paid, returned a dividend of L.2000. In fact, the revolution of July was the royal reign of the press, when the two journals already mentioned enjoyed an almost supreme authority. But since that period it appears to have undergone very considerable changes. The republican party was the first to multiply its organs. In a short time it brought out the *National*, the *Mouvement*, the *Révolution*, the *Tribune*, the *Patriote*, the *Avenir*, the *Réformateur*, the *Populaire*, and the *Bons Sens*. The two last were Sunday papers, which only cost one penny each, and were sold by hawkers. As many as 50,000 copies of the *Bons Sens* have been sold in this manner in one day. But the law which subjected the public hawkers to the monopoly of the police put a stop to this traffic; the republican press shared the same fate as the republican *emeutes;* and subsequent enactments gave it the *coup de grace*. The *Bons Sens* and the *National*, however, still maintain a languishing existence as daily papers. From 1832 to 1835, whilst the *tiers-parti*, headed by Dupin, had a majority in the Chambers and in the country, several journals were published in harmony with that state of affairs, and some of the old ones moderated their tone, or changed their denominations. In 1836, newspapers were founded, not in support of any party or opinion, but purely on speculation, the profits realized by a few fortunate journals having tempted adventurers to embark in such undertakings. We may add, that a few enterprising individuals have undertaken to bring the daily press in France to the level of the humblest fortunes, by publishing newspapers at forty francs, or L.1. 12s. per annum. The projector of this system was M. Emile Girardin, deputy of the Creuse, whose own paper, *La Presse*, has obtained a circulation of about 12,000. But the ultimate success of the experiment is far from being certain.

We have no means of ascertaining with any degree of precision the actual number of the French journals, and the extent of their circulation respectively. In an article written in 1829, and inserted in the *Compilateur*, the author, speaking of things as they then stood, says, "There are in Paris a hundred and fifty-two journals, literary, scientific, and religious, and seventeen political; in all a hundred and sixty-nine. Of these papers a hundred and fifty-one are constitutional, or, as they are called, liberal, the eighteen others being more monarchical in their spirit. The hundred and fifty-one constitutional journals have, it is stated, 197,000 subscribers, 1,500,000 readers, and produce an income of 1,155,000 francs (L.46,200); the eighteen others have 21,000 subscribers, 192,000 readers, with an income of 437,000 francs (L.17,480). The *Moniteur*, the official paper, has from 2500 to 4000 subscribers, principally public functionaries; the *Constitutionnel*, from 18,000 to 20,000 subscribers; the *Journal des Débats*, from 13,000 to 14,000 subscribers; the *Quotidienne*, 5000 subscribers; the *Courrier Français*, 4500 subscribers; the *Journal du Commerce*, 3500 subscribers; the *Gazette de France*, 7000 subscribers; the *Messager des Chambres*, 2500 subscribers; the *Tribune des Départements*, a new paper, 100 subscribers; and the *Nouveau Journal de Paris*, from 1000 to 1500

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[1] When General Foy died, the daily press called upon the country to provide for his children, and a million of francs was soon subscribed. The same power collected 200,000 persons to attend the obsequies of Manuel, in presence of the guards drawn out, and at the risk of a battle. At the general election, in 1827, the press designated the candidates, and decided the contests. More recently, the funeral of General Lamarque was attended by an immense assemblage, which the press had called together, at the imminent hazard of another conflict in the streets of Paris.

subscribers. All these are published in the capital. The journals printed in the provinces are calculated at seventy-five, exclusive of papers for advertisements and ministerial bulletins. Of these, sixty-six are constitutional, being supported only by subscribers of the same way of thinking. One, the *Mémorial de Toulouse*, is supported by the archbishop of that diocese; four are, it is asserted, paid from the secret funds of the Jesuits; and the other four are monarchical, but possess little influence." Since the period to which this applies, however, great changes have taken place, and the circulation of some of the leading daily journals has declined. Nevertheless, it appears that a share in the *Constitutionnel* is still worth twenty-five times its original cost; that the shares in the *Gazette des Tribunaux*, which, at the outset, were worth only 500 francs, are now sold for 30,000; and that the *Gazette de France* has, for a long time, brought the proprietor an income of 200,000 francs, or L.8000 a year.

In Germany, newspapers originated in the *Relations*, as they were termed, which sprung up at Augsburg and Vienna in 1524, at Ratisbon in 1528, at Dillingen in 1569, and at Nuremberg in 1571, and which appeared in the form of letters printed, but without date, place, or number. The first German newspaper in numbered sheets was printed in 1612, and entitled "Account of what has happened in Germany and Italy, Spain and France, the East and West Indies, and other countries." Since that time, public papers have successively appeared in different places, and under various titles, but all of them subject to a strict censorship. In Germany, however, as in France, the periodical press was of little importance till the era of the French Revolution, and, in comparison with the state of matters in these countries, it has always remained so. By the resolutions of the German Diet in 1819, it was placed under strict supervision, and still continues subject to a vigilant censorship. Till the commencement of the French Revolution, the *Hamburger Correspondent* was almost the only paper in Germany which derived its information respecting foreign countries from original correspondence; and at that time its sale was estimated at between 30,000 and 36,000 copies. Subsequently, however, it declined, principally owing to the occupation of Hamburg by the French, and its sale amounted to only a few thousands. In the year 1828, twenty-one gazettes, daily and weekly, were published at Hamburg. But a new kind of periodical sprang up in Germany in the year 1798, and soon outstripped all others. This was the *Allgemeine Zeitung*, or Universal Gazette, established by Cotta, a bookseller in Tubingen, and destined to become an important political organ. The *Allgemeine Zeitung* is now published at Augsburg. In all the countries of Europe it has correspondents, who supply it with intelligence; and both the German and foreign governments frequently make use of it to influence public opinion by demi-official articles. This has been done with much dexterity by the Austrian government, especially in its transactions respecting paper money and the public stocks; and even the French ministry have, it is said, occasionally made use of it for similar purposes. But with all these advantages, the sale is small, not exceeding 2000 or 2500, and barely covers the expenses. The deliverance of Germany in the year 1813 gave rise to a number of political papers, all imbued with the awakened spirit of the times. Kotzebue and Niebuhr each commenced a journal of this description; but both were soon discontinued. The most celebrated gazette of this period was the *Rheinische Merkur* of Görres, which appeared in January 1814, and terminated its career in the beginning of 1816. The *Oestereichische Beobaster*, or Austrian Observer, was established by the private secretary of Prince Metternich, and, as the official organ of the cabinet of Vienna, it speedily acquired a considerable circulation. The German papers of amusement originated with the *Zeitung für die Elegante Welt*, which was established at Leipzig in 1801. The number of papers of this description has since been constantly increasing, although many of them have perished as rapidly as they arose. But of those which have maintained their ground, the most important are, the *Morgenblatt* of Stuttgart, the *Abendzeitung* of Dresden, the *Gesellschafter* of Berlin, and the *Litterarische Wochenblatt*, established by Kotzebue. Of all these, however, the *Morgenblatt* has the greatest sale.

Journals of Italy, Spain, &c.

Italy, Spain, and Portugal, present little worthy of notice as respects the newspaper press. Of the Italian journals, the *Gazetta di Firenze*, the *Gazetta di Milano*, and the *Diario di Roma*, are almost the only ones which are read in foreign countries. The *Giornale Arcadico di Roma* embraces literature, the fine arts, and miscellaneous subjects, and the *Eco di Milano* endeavours to keep up a literary intercourse between Italy and other countries. The *Gaceta* of Madrid has a semi-official character, but in other respects is undeserving of notice. Lisbon has also its organ for the publication of official documents and communications. In Belgium and Holland there are, in French and Dutch respectively, a considerable number of daily and weekly papers, besides monthly publications. In 1830 Switzerland had twenty-four weekly papers, and five others which appeared once a fortnight. The first Russian paper was published in 1703, under Peter I. In 1829 the number of papers and periodicals published in the Russian empire was seventy-three; but the only important political journals are the *Gazette de St Petersbourg* and the *Journal de St Petersbourg*, both of which are written in the French language. In Sweden there is not much opposition nor independence amongst the newspapers, and political discussion is at a very low ebb. An interesting account of the Norwegian journals will be found in Laing's Residence in Norway, to which the reader is referred. Denmark has about eighty journals, of which twenty-three are devoted to politics, and twenty-five to the sciences.

Greek and other papers.

The Greeks have now several newspapers in their own language, though none of them exerts any considerable influence, or has a numerous subscription. A journal is also published at Corfu. In Smyrna the *Spectateur Oriental* was in 1827 displaced by the *Observateur Impartial*, and subsequently by the *Courrier de Smyrne*, which is conducted in a spirit friendly to the sultan. At Constantinople the *Moniteur Ottoman* is published in French under the sanction of the sultan; and the viceroy of Egypt has likewise his official organ, in the same language, printed at Boulak, near Cairo.

American newspapers.

The increase of newspapers in the United States has been much more rapid than in England. The total number of newspapers annually issued in the Union has been estimated at from 55,000,000 to 60,000,000, whereas the total number issued in Great Britain and Ireland during the year 1833 was only 34,515,221. It follows that, making allowance for the difference of population, every individual in America has, at an average, more than twice the supply of newspapers enjoyed by each person in England. From the low price of the American, as compared with the English and even the French newspapers, they are liberally patronised by all classes, and are to be seen in almost every dwelling and counting-house, and in all hotels, taverns, and shops. But we must not estimate the value nor the influence of newspapers by their quantity alone. Regard must likewise be had to its quality, which indeed is the principal consideration to be attended to. But in whatever degree the American may exceed the English or French journals in number, they sink immeasurably below them in point of quality. In the United States the state of the newspaper press is such that it can scarcely descend lower; indeed it may be considered as a disgrace

Newspapers.

to the country. These journals, with but few exceptions, indulge in the most offensive, and often brutal personalities. Instead of examining the principles of measures, they assail the character and misrepresent the motives of those by whom they are introduced; and, in fact, it would be difficult to name an individual of any distinction who has not been libelled and calumniated by a large portion of the press, to a degree which can scarcely be imagined. The magnitude of the evil, however, will in all probability lead to its cure. It can scarcely be supposed that an intelligent and well-instructed people will long continue to patronise a press which traffics in misrepresentation, scurrility, and exaggeration, and which, besides the outrages it commits against individuals, opposes a serious obstacle to wise government and well-considered improvement.

From the immense number of newspapers circulated in the United States, as compared with the population of the country, it follows that the number of subscribers to each paper must be limited; indeed 2000 is considered as a respectable list. The consequence is, that one paper is unable to command the talents of several able men, as in France, and that, in the general scramble, the object is rather to flatter the known prejudices, and minister to the bad passions of the people, than to enlighten their understandings by inculcating sound principles, or enforcing salutary truths. Their abundance, however, happily neutralises their effects. Declamation and sophistry are rendered comparatively innocuous by running in a thousand conflicting currents. But the case would be very different, and the evil altogether intolerable, if there were in the United States only a few papers, with from 25,000 to 30,000 subscribers, and perhaps five times as many readers. Upon such a supposition, journalism would be as influential in America as in France, and in its effects ten times more dangerous. To show the progressive extension of the American newspaper press, it is only necessary to state, that at the commencement of the revolutionary war in 1775, the number of newspapers published in the United States was only thirty-seven; that in 1810 it had increased to 359; that in 1828 it exceeded 850; and that in 1834 it amounted to no less than 1265. At this time the number of daily papers published within the Union was ninety, and that of other periodical journals 130.

Comparative estimate.

A comparison of the number of periodicals and inhabitants of different countries, made in the year 1827, gave the following results. At that time there appeared in the United States upwards of 800 journals to 11,600,000 inhabitants; in Great Britain, 483 different newspapers to 23,400,000 inhabitants; in Sweden and Norway, eighty-two journals to 3,866,000 inhabitants; in Denmark, eighty journals to 1,950,000 inhabitants; in Prussia, 288 journals to 12,416,000 inhabitants; in the Netherlands, 150 journals to 6,143,000 inhabitants; in the German confederation, exclusive of both Austria and Prussia, 305 journals to 13,300,000 inhabitants; in Saxony, fifty-four newspapers to 1,400,000 inhabitants; in Hanover, sixteen newspapers to 1,550,000 inhabitants; in Bavaria, forty-eight newspapers to 3,960,000 inhabitants; and in France, 490 periodical publications of all kinds to a population of about 32,000,000. A comparison of the number of periodicals and inhabitants in different capitals gives results scarcely less varied. Thus, Stockholm, with 38,000 inhabitants, has thirty journals; Rome, with 154,000, has only three; Berlin, with 221,000, has fifty-three periodical works; Copenhagen, with 109,000 inhabitants, has fifty-seven journals; and in Paris, which contains a population of nearly 900,000, there are 176 periodical works. Since the date to which this comparison refers, however, the numbers in both respects must have varied considerably; but it is probable that the relative proportions remain pretty nearly the same. It may also be observed, that no general conclusion as to the state of intellectual culture or of political information amongst a people can safely be deduced from such comparative expositions as that which is above given. The proportional number of journals circulated in the United States is much greater than in any other country; yet, as we have already shown, they are the most worthless, and consequently the least calculated to diffuse useful knowledge, or to excite a spirit of inquiry, of any in the world.

General remarks.

Much has been said both as to the absolute and the comparative effects, moral and political, produced by newspapers, in those countries where they are freely circulated; and there is room for considerable diversity of opinion respecting the degree and the kind of influence which they exert upon the sentiments and opinions of the public. But that this influence must be considerable, in whatever mode or direction it may operate in particular cases, or under peculiar circumstances, there can be no doubt at all, even amongst those who differ most widely as to its real character and effects. It will of course vary according to the relative condition of different classes or communities in point of information; but the joint effect and full result of its continual appliance can scarcely fail to be very considerable, even where its action is least concentrated. The power of the newspaper press depends, not on single and disjoined impulsions, but on the aggregate effects of constantly reiterated action; it is a practical exemplification of the proverb, that the drop hollows the stone, *non vi sed sæpe cadendo*. All experience shows, that any agency or force, however small, if continually applied in the same direction, and towards the same object or objects, will in course of time produce the greatest results. Still, in different countries, variously circumstanced in point of education and general information, considerable diversity may be observed in the operation of this power, and in the mode in which it attains its ultimate effect upon the public mind. Where the mass of the people are comparatively enlightened, and more or less habituated to reflection, the press, in order eventually to govern, must begin by following the current of opinion. It cannot stem, but it may divert, the stream; it must not begin by opposing a direct resistance, but by skill and address it may ultimately succeed in turning it into a new channel, and in some measure governing it at pleasure. In such cases, there is both action and re-action. Public opinion acts upon the press, and the press re-acts upon public opinion, with an accumulating force, of which, in certain circumstances, it is difficult to exaggerate the extent and the power. But it is otherwise in countries where the mass of the people are comparatively unenlightened, and unaccustomed to form an independent judgment amidst the conflict of antagonist opinions. There the press is a real and direct power, which acts at once on the public mind, and which, if left to act uncontrolled, may eventually produce the most baneful, not to say fatal, impressions. In the former case, there is a check in the pre-existent condition of society; in the latter, there is none whatever, except that which may happen to be applied by the law.

From an elaborate calculation made in the year 1819, it was inferred that, including the provincial journals, an Englishman reads daily twenty or thirty times as much as a Frenchman does of the newspapers of his country. This calculation may have been exaggerated, and the disparity is probably much less now than it was eighteen years ago; but it is nevertheless evident that the balance of the newspaper reading, all kinds of journals included, is still on the side of the Englishman, who, again, is exceeded in this respect by the North-American. Yet, in France, the journals exert a much more direct influence upon public opinion than either in England or in America. They constitute a sort of power in the state, which is altogether irresponsible within the limits prescribed by the law, that is, in its ordinary exercise; and they give the tone to the sentiments and opinions of the nation. They are not so much mirrors which reflect the state of the public mind, as agencies which impart to it whatever bias or tendency they please. Journalism in that country is therefore seen under a different aspect from that in which it appears in almost any other; and hence it has been an object of constant vigilance and suspicion on the part of the general government. But if its influence be greater in France than elsewhere, that influence has also been more contested. From its birth, as it displayed a tendency to absorb every thing, so nothing was granted to it without a struggle. No power has ever excited more alarm, has had more enemies, has survived severer trials, or has undergone more singular revolutions. From 1789 to 1830, the ordinary condition of the French press was a rule of censorship and oppression; the rare intervals of liberty vouchsafed to it only served as moments of rest to take breath in that adventurous campaign, every advance in which was won by hard fighting. Yet the power of the press has grown amidst these trials; the bonds which were imposed upon it to check its movement have fortified its strength, and it is now a sort of dictatorship in the state. The existence of this extraordinary power is accounted for by the circumstances of the country. In Great Britain, and in the United States, where a representative government is firmly established, each political power occupies its natural place, without transgressing the limits of its proper sphere of action. The press does not invade the province of the legislative chambers, nor do the latter encroach upon the domain of the press. But in France the government is still at a stage of experiment and difficulty; it alternately looks back to the past, and forward to the future, seeking its equilibrium and its point of rest. The time is not yet come for it peaceably to work out its established principle, because that principle is still a matter of doubt and debate; and as long as this experimental state of things shall continue, the constituted powers will have only a secondary importance, and the press, which takes the lead and opens the road to discovery, will necessarily govern the country. But, in a country like Great Britain, where the great body of the people are possessed of information, and the habit of political discussion has long been formed and matured; where the conflicts of party enter as an essential element into the practical working of the constitution, and there exists a steady independent opinion, upon which violence and exaggeration are powerless, except in periods of great public excitement; the press is rather an exponent or index of the feelings, sentiments, and opinions of the people, than a controlling or governing power, assuming the form of a dictatorship, and really constituting an *imperium in imperio*, as in France. The whole action of government is concentrated in the houses of parliament and in the hands of the administration; and the press is restricted to its proper function, namely, the criticism of events and of public opinions. The people, too, are trained and habituated to this state of things. They are not the slaves, but the patrons, and even the critics, of the press; nor are their minds primarily moved by its speculations, commentaries, and arguments, directed, as these generally are, towards the support of some particular set of opinions. Party journals are for the most part read as such, and the statements or reasonings of one set of writers are coolly compared with those of another. There is nothing, or next to nothing, of that undoubting faith, or that blind credulity, which leads men to believe merely because it is written. Even the warmest partisan will not submit his understanding to the exclusive guidance of the writer whom, perhaps, he in general most admires and approves of; and hence the best safeguard against the abuse of free discussion, or the licentiousness of the press, is to be found in the inherent stability of our institutions, and the sense, intelligence, and morality of the people.

(See Chalmers' *Life of Ruddiman; Periodical Press of Great Britain; Babylon the Great; The Great Metropolis;* M'Culloch's *Commercial Dictionary and Supplement*, 1836 and 1837; *Le Compilateur;* Girardin, *Moyens Legislatifs pour régenérer la Presse*, 1835; *Encyclopædia Americana*, article NEWSPAPERS; the *American Almanac* for 1835; *La Chronique Suisse; Swedish Language and Literature; Statistique et Itinéraire de la Russie; Edinburgh Review*, vols. xxxii. and xxxviii.; *British and Foreign Review*, No. xiii. April 1837.) (A.)

NEWTON, a town of the county of Lancaster, in the parish of Winwick, and the hundred of West Derby, distant 179 miles from London. It is a borough, and was a market-town, and it had the right of electing two members to the House of Commons, but has been disfranchised. It has some trade in cotton goods. The population amounted in 1801 to 1455, in 1811 to 1589, in 1821 to 1643, and in 1831 to 2139.

NEWTON, a town in the Isle of Wight, within the parish of Colbourn, which formerly returned two members to the House of Commons, but has been disfranchised. It has a good harbour, which, however, is but little resorted to.

NEWTON, a market-town of the county of Montgomery, in South Wales, distant 178 miles from London, and sometimes called Trenewydd. It is situated in a pleasant and fertile district on the banks of the Severn. It shares with Montgomery and four other towns the right of electing one member to the House of Commons. It has a market, which is held on Saturday. The population amounted in 1801 to 990, in 1811 to 2025, in 1821 to 3486, and in 1831 to 4550.

NEWTON-BUSHEL, a town of the county of Devon, 187 miles distant from London. It is situated on the river Teign, about four miles from its mouth, in Torbay. There is a market, which is held on Wednesday. As it is composed of portions of two parishes, the population of the town in the last census is not distinguished from that of the parishes.

NEWTON, SIR ISAAC, a distinguished mathematician and natural philosopher, was born at Woolsthorpe, a picturesque hamlet about half a mile to the west of Colsterworth, in Lincolnshire, and some six miles to the south of Grantham. His birth, which was premature, took place on the 25th of December, O. S. 1642. His father, Mr Isaac Newton, was proprietor of Woolsthorpe to the extent of about L.30 per annum, and farmed it with his own hands. His mother was Harriet Ayscough, the daughter of Mr James Ayscough, of Market-Overton, in Rutlandshire. They had been married only a few months when Mr Newton died, leaving his wife in a state of pregnancy. The posthumous child was so small that "they might have put him into a quart mug," and no expectation was entertained of his continuing to live. "Providence, however," as his biographer observes, "had otherwise decreed; and that frail tenement, which seemed scarcely able to imprison its immortal mind, was destined to enjoy a vigorous maturity, and to survive even the average term of human existence." Mrs Newton possessed a small property in Leicestershire, about three miles from Woolsthorpe, which raised her annual income to about L.80.

In consequence of the marriage of Mrs Newton to the Rev. Mr Smith of North Witham, she left her son Isaac under the charge of her mother. He received his early education at two day schools at Skedington and Stoke; and in his twelfth year he went to the public school at Grantham, taught by Mr Stokes, and was boarded at the house of Mr Clark, an apothecary. Here his attention was less occupied with his studies than with the mechanical amusements, in which he spent all his leisure hours. Models of wind-mills, water-clocks, and self-moving carriages, were executed by him in succession; and he contrived to amuse his schoolfellows with paper kites and paper lanthorns, which he raised to great heights in the air.

From the play-things of his childhood, Newton made a rapid transition to higher amusements. The daily movements of the sun were traced upon the walls and roofs of the buildings at Woolsthorpe, and by means of pins and lines he indicated the hours and half hours of his rude dials; and though he was now employed in tending the cattle, and going to the market at Grantham, yet he was often found studying mathematics under a hedge, or gleaning fragments of science from old books in Mr Clark's garret at Grantham. This inattention to the duties of the farm increased with his years, and his mother came to the resolution of giving him an academical education. After the preparation of a few months at Grantham School, he was sent to Cambridge, where he was admitted of Trinity College on the 5th of June 1660, in the eighteenth year of his age. He was admitted a subsizer in 1661, a bachelor of arts in 1665, a junior fellow in 1667, and master of arts in 1668. Young Newton's attention was first turned to the study of mathematics by a passion for judicial astrology. He considered the propositions in Euclid as self-evident truths; and in the geometry of Descartes, the Miscellanies of Schooten, the *Clavis* of Oughtred, and the Arithmetic of Infinites of Wallis, he acquired his first knowledge of the mathematics. Kepler's Optics and Saunderson's Logic were amongst the books which he carefully studied, and upon which he wrote comments; and so rapid was his progress in knowledge, that he was considered as being more deeply versed in several branches than his own tutor. In the year 1664 he purchased a prism for the purpose of studying Descartes' Theory of Colours; but he does not seem to have made any special use of it. In 1666 he purchased another prism; and early in 1668 three additional prisms, which were no doubt those which he used in his experiments. He had in 1666 applied himself to the grinding of "optic glasses of other figures than spherical;" and finding that there were other causes than the imperfect converging of rays to a focus which rendered refracting telescopes imperfect, he was led to inquire into the cause of the colours produced by lenses and prisms, and to make those splendid discoveries respecting the different refrangibility of the rays of light, the history and nature of which has been given in the article on Optics.

Having despaired of improving the refracting telescope, Newton directed his attention to the reflecting one. At this time Gregory's *Optica Promota*, published in 1663, fell into his hands; and, in considering the construction of the Gregorian telescopes there described, "he found the disadvantages of them so great," "that he altered the design of them, and placed the eye-glass at the side of the tube rather than at the middle." On this altered principle he executed a reflecting telescope with his own hands in the year 1668. In 1671 he executed a better one, which was shown to the king, and presented to the Royal Society, in whose custody it still remains.

Although Newton delivered a course of lectures on optics in Cambridge in 1669, 1670, and 1671, containing an account of his discoveries respecting the different refrangibility of the rays of light, yet the Royal Society was not acquainted with them till 1672. On the 23d of December 1671, he was proposed as a member of that body by Dr Seth Ward, bishop of Sarum, and he was elected on the 11th of January 1672. On the 6th of February he communicated to Mr Oldenburg his discoveries respecting light, which he regarded as "the oddest, if not the most considerable, detection which had hitherto been made in the operations of nature."

No sooner was it communicated to the world that *white* light consists of seven different colours, having different degrees of refrangibility, than a crowd of obscure individuals assailed, not only his conclusions, but the accuracy of the experiments from which they had been derived. Dr Hooke and Huygens attacked them on different grounds; but Newton, in a letter to Oldenburg, dated the 11th of June 1672, silenced the arguments of his opponents, and established his general doctrine upon an impregnable basis.

The colours of thin plates, first observed by Boyle, and studied by Hooke, had occupied the special attention of Newton. The results of his inquiries were laid before the Royal Society on the 7th of December 1675, and about twelve years afterwards the theory of fits was completed, and applied to the explanation of the permanent colours of natural bodies. These researches, however, including his experiments on the inflexion of light, which he gives only as an imperfect fragment, were not published till 1704, when his treatise on Optics appeared. For a full account of these discoveries the reader is referred to the article Optics.

The first idea of gravity as the cause of the celestial motions occurred to Newton in the year 1666, when sitting alone in the garden of Woolsthorpe. Conjecturing that it might extend as far as the moon, he was led to confirm the conjecture by calculation, and thus to establish the doctrine of universal gravitation, "that every particle of matter is attracted by, or gravitates to, every other particle of matter, with a force inversely proportional to the squares of the distance." This great discovery, and its application to the movements of the planetary system, as well as to that of the comets, was published in 1686, in his *Philosophiæ Naturalis Principia Mathematica*, a work which, to use the words of Newton's biographer, "is memorable, not only in the annals of one science or one country, but will form an epoch in the history of the world, and will ever be regarded as the brightest page in the records of human reason." This remarkable production was speedily circulated over Europe; and although the discoveries which it contained were for a while opposed by national as well as personal jealousies, yet the Newtonian philosophy made rapid progress, and finally supplanted the rival systems of Aristotle and Descartes.

As early as the year 1666, Newton had discovered the binomial theorem and the method of fluxions; and although he had not communicated this discovery to any of his friends, yet he had clearly described the principle, and exhibited the application of his method, in his *Analysis per Equationes numero Terminorum infinitas*, a work which he had communicated to Dr Barrow in June 1669, and which was not published till 1701, nearly half a century after it was written. Our readers are well aware that the discovery of fluxions was claimed by Leibnitz, and that the controversy which sprung out of this claim is scarcely yet at an end.[1]

From the year 1669, when Newton was appointed to succeed Dr Barrow as Lucasian professor of mathematics at Cambridge, till 1688, he led a secluded life within the walls of his college; but events now occurred which drew him from retirement, and placed him conspicuously on the stage of public life. James II., desirous of re-establishing the Catholic faith as the national religion, had begun to assail the privileges of his Protestant subjects. He ordered Father Francis, an ignorant Benedictine monk, to be received at Cambridge as a master of arts, and the oaths of allegiance and supremacy to be dispensed with. The university resisted this illegal mandate, and chose

[1] A full account of this controversy will be found in the article Fluxions, vol. ix. p. 633; and Leibnitz, vol. xiii. p. 208.

nine delegates to defend their independence. Having joined in resisting the wishes of the court, Newton was chosen one of the delegates; and such was their firmness, and the argumentative weight of their representations, that the king was led to abandon his design. Newton's popularity was extended by the success of the delegates, and he was elected member for the university in 1688, along with Sir Robert Sawyer, having beaten Mr Finch by only five votes. Newton sat in the convention parliament from January 1689 till its dissolution in February 1690.

In the discharge of his parliamentary duties, he no doubt experienced the unsuitableness of his income to his new position. The limited means of his relations, and his own generous disposition, had exhausted his scanty resources, and he and his friends naturally looked to some patronage on the part of the government which might enable him to pursue his scientific researches, unembarrassed by those physical wants which have ever been the scourge of genius, and especially of that variety of it which is called forth by patient and continuous inquiry. There is ample evidence that unsuccessful applications had been made for this purpose, and the vexation and disappointment which this ingratitude produced, combined with other causes, seem to have thrown Newton into a state of nervous irritability, which threatened to paralyze even his mighty intellect. It is difficult to trace with distinctness the succession of causes which at this time contributed to disturb his serenity; but it appears that, about the end of 1692, or early in 1693, his chemical laboratory had been burned, and a number of manuscripts destroyed; and on another occasion, several valuable manuscripts were consumed by a candle which he had left burning whilst he went to chapel. These losses seem to have affected him deeply, and "he was so troubled thereat, that every one thought he would have run mad, and he was not himself for months after." Another account of these events, communicated by one Colin or Collins to Huygens,[1] represents Newton as having actually become insane, and unable to understand his own writings; and, relying upon the accuracy of this statement, M. Biot and other French philosophers considered his insanity as the reason why Newton had ceased to make scientific discoveries. They even went so far as to ascribe his study of theology to this enfeebled state of mind, and thus to deprive our faith of that support which it derived from having been illustrated and defended by so great an expositor and champion.

That the mind of Newton was sound and active during the period when it is said to have been seriously disturbed, may be proved by many undoubted facts. In this interval he composed his four celebrated letters to Dr Bentley on the existence of a Deity; letters which evince a power of thought, and a serenity of mind, incompatible even with the slightest obscuration of his faculties. The first of these letters was written on the 10th of December 1692, the second on the 17th of January 1692–3, the third on the 25th of February, and the fourth on the 11th of February 1693–4. In 1692 we find him also engaged in mathematical researches on the quadrature of curves, and in observations on halos; and in November and December 1693 he was occupied in discussing mathematical questions with his correspondents. On the 1st of September 1694 Newton visited Flamsteed at Greenwich, and he was at that time occupied with the difficult and profound subject of the lunar theory.[2]

That Newton's health was affected from the middle of 1692 to the middle of 1693, is quite certain; and that his nervous system was shaken by loss of sleep and appetite, is mentioned by himself. Exaggerated rumours had reached his friends in London, and Mr Pepys was led to inquire of his friends at Cambridge if these rumours of a discomposure of his mind had any foundation. Mr J. Millington, who, we believe, was tutor of Magdalene College, returned the following answer:—"I was, I must confess, very much surprised at the inquiry you were pleased to make by your nephew about the message that Mr Newton made the ground of his letter to you, for I was very sure I never either received from you or delivered to him any such; and therefore I went immediately to wait upon him, with a design to discourse with him about the matter; but he was out of town, and since I have not seen him, till, upon the 28th, I met him at Huntingdon, where, upon his own accord, and before I had time to ask him any question, he told me that he had writt to you a very odd letter, at which he was much concerned; added, that it was in a distemper that much seized his head, and that kept him awake for about five nights together, which upon occasion he desired I would represent to you, and beg your pardon, he being very much ashamed he should be so rude to a person for whom he hath so great an honour. He is now very well, and though I fear he is under some small degree of melancholy, yet I think there is no reason to suspect it hath at all touched his understanding, and I hope never will; and so I am sure all ought to wish that love learning, or the honour of our nation, *which it is a sign how much it is looked after*, WHEN SUCH A PERSON AS MR NEWTON LYES NEGLECTED BY THOSE IN POWER."

In the beginning of the year 1692, Charles Montague, Lord Monmouth, and Mr Locke, were exerting themselves to obtain some appointment for Newton. In his letters to Locke, Newton himself refers, with a considerable degree of feeling, to these exertions. He conceived that Charles Montague, under the influence of some old grudge, had been false to him, and that there had been a design to sell

[1] The following extract from the manuscript of Huygens was first published in Biot's Life of Newton. "On the 29th of May 1694, M. Colin (*Collins* or *Colm*), a Scotsman, informed me that, eighteen months ago, the illustrious geometer Isaac Newton had become insane, either in consequence of his too intense application to his studies, or from excessive grief at having lost by fire his chemical laboratory, and several manuscripts. When he came to the Archbishop of Cambridge, he made some observations which indicated an alienation of mind. He was immediately taken care of by his friends, who confined him to his home, and applied remedies, by means of which he had now so far recovered his health that he began to understand the *Principia*."

The following extract from a manuscript journal kept by Mr Abraham de la Pryme, an ancestor of Professor Pryme, when a student at Cambridge, throws much light on this part of Newton's life. "1692, Feb. 3. What I heard to-day I must relate. There is one Mr Newton (whom I have very often seen), fellow of Trinity College, that is mightily famous for his learning, being a most excellent mathematician, philosopher, divine, &c. He has been fellow of the Royal Society these many years; and, amongst many other very learned books and tracts, he has written one upon the mathematical principles of philosophy, which has got him a mighty name, he having received, especially from Scotland, abundance of congratulatory letters for the same. But of all the books which he ever wrote, there was one of *Colours and Light*, established upon thousands of experiments, which he had been twenty years of making, and which had cost him many hundreds of pounds. This book, which he valued so much, and which was so much talked of, had the ill luck to perish and be utterly lost, just when the learned author was almost at putting a conclusion to the same, after this manner. In a winter's morning leaving it among his other papers on his study table, whilst he went to chapel, the candle, which he unfortunately left burning there too, catched hold by some means of other papers, and they fired the aforesaid book and utterly consumed it, and several other valuable writings; and, which is most wonderful, did no further mischief. But when Mr Newton came from chapel, and had seen what was done, every one thought he would have run mad; he was so troubled thereat, that he was not himself for a month after." (Brewster's Life of Newton, p. 228.)

[2] Baily's Account of the Life of Flamsteed, p. 61, 133.

Newton. him an office; and it is to the failure of these attempts that Mr Millington alludes with such just severity in the letter which we have quoted.

Newton was now in the fifty-third year of his age; and whilst those of his own standing at the university had been appointed to high stations in the church, or to lucrative offices in the state, he still remained without any mark of national gratitude. His fellow-labourers in science in every part of Europe were enjoying the favour and protection of their respective sovereigns, who had even invited foreign philosophers to their capitals to enjoy the liberality which they had extended to their own. Foreigners viewed with astonishment the treatment of Newton by his own sovereign, and the French king had the nobleness of mind to offer him, through Cassini, a liberal pension.

But this blot upon the English name was at last removed by Charles Montague, when, in the year 1694, he was appointed chancellor of the exchequer. He had previously consulted Mr Newton upon the subject of the recoinage; and when Mr Overton, the warden of the mint, was made a commissioner of customs, he served both his friend and his country by appointing Newton to that important office. "I am very glad," says he, "that *at last* I can give you a good proof of my friendship, and the esteem the king has of your merits. Mr Overton, the warden of the mint, is made one of the commissioners of the customs, and the king has promised me to make Mr Newton warden of the mint. The office is the most proper for you. 'Tis the chief office in the mint; 'tis worth five or six hundred pounds per annum, and has not too much business to require more attendance than you can spare."

The chemical and mathematical knowledge of Newton proved of great use in carrying on the recoinage, which was completed in about two years; and such was the zeal and devotion with which Newton discharged the laborious duties of this office, that he was appointed, in 1697, to the mastership of the mint, which was worth between twelve and fifteen hundred pounds per annum. In this situation he drew up a table of assays of foreign coins, and composed an official report on the coinage. Having retained his professorship at Cambridge whilst he was warden, he now appointed Mr Whiston as his deputy, with all the emoluments of the chair.

In the same year Newton was elected a foreign associate of the Royal Academy of Sciences at Paris. In 1701 he was elected one of the members of parliament for the University of Cambridge. In 1703 he was raised to the presidency of the Royal Society of London, to which he was annually re-elected during the remaining twenty-five years of his life.

When Queen Anne and the court visited Cambridge on the 16th of April 1705, she conferred the honour of knighthood on Mr Newton.

On the dissolution of parliament in 1705, Sir Isaac was again a candidate for the representation of the university; but he was beaten by a great majority. He was supported by all the resident members; but being a whig in politics, and the cry of the church in danger having been raised on that occasion, he became the victim of the ignorance and fanaticism of the non-resident constituency.

The first edition of the *Principia* having been sold off, Dr Bentley and his other friends had, for a considerable time, been urging Sir Isaac to prepare a new edition. The duties of the mint would not permit him to devote much time to such a task; but he willingly complied with the request of his friends, when Mr Roger Cotes, Plumian professor of astronomy at Cambridge, undertook to superintend its publication. Newton promised to send his own revised copy to Mr Cotes in July 1709; but delays took place, and the work was not completed till the spring of 1713. Nearly three hundred letters passed between Sir Isaac and Cotes, in which the various alterations and additions are discussed; and this correspondence, at least the letters of Newton to Cotes, has been carefully preserved in the library of Trinity College, Cambridge.

When George I. succeeded to the throne of Great Britain, Sir Isaac became an object of interest at court. The Princess of Wales, afterwards queen-consort to George II. took great pleasure in conversing with him, and in corresponding with Leibnitz. Having one day mentioned to her royal highness a new system of chronology which he had composed whilst resident at Cambridge, she requested Sir Isaac, through the Abbé Conti, to give her a copy of it. He accordingly drew up an abstract of it from the loose papers to which it had been committed, and sent it to the princess for her private use alone. He afterwards allowed a copy to be given to the Abbé Conti, on the condition of its not being communicated to any person whatever. The abbé, however, forgetting his obligation, communicated it to M. Fréret, a learned antiquary in Paris, who translated it, and endeavoured to refute it. It was printed early in 1725, under the title of *Abrégé de Chronologie de M. le Chevalier Newton, fait par lui-même, et traduit sur le Manuscrit Anglais.* Upon receiving a copy of this work, Sir Isaac Newton printed, in the Philosophical Transactions for 1725, a paper, entitled Remarks on the Observations made on a Chronological Index of Sir Isaac Newton, translated into French by the observator, and published at Paris. In these remarks Sir Isaac charges the abbé with a breach of promise, and gave a triumphant answer to the objections which Fréret had urged against his system. Father Souciet entered the field in defence of Fréret; and, in consequence of this controversy, Sir Isaac was induced to prepare his larger work, which was published in 1728, after his death, and entitled the Chronology of Ancient Kingdoms amended; to which is prefixed, a short Chronicle from the First Memory of Kings in Europe to the conquest of Persia by Alexander the Great.

There is no part of Sir Isaac Newton's biography more remarkable than that which relates to his theological studies. From a very early period of his life Newton had seriously embarked in the study of theology. Previously to 1692 he was known by the appellation of an excellent divine, and it is well known that he had begun to study the subject of the prophecies before 1690; whereas, in order to show that his theological writings were the productions of his dotage, and subject to his supposed mental alienation, M. Biot has fixed their date between 1712 and 1719, between the seventieth and the seventy-fifth year of his age.

One of the most remarkable of Sir Isaac's theological productions is his Historical Account of Two Notable Corruptions of the Scripture, in a letter to a friend. This friend was Mr Locke, who received the letter in November 1690. Sir Isaac seems to have been then anxious for its publication; but as the effect of his argument was to deprive the Trinitarians of two passages in favour of the Trinity, he became alarmed at the probable consequences of such a step. He therefore requested Locke, who was then going to Holland, to get it translated into French, and published on the Continent. Being prevented from going to Holland, Locke copied the manuscript, and sent it, without Newton's name, to M. le Clerc, who received it before the 11th of April 1691. On the 20th of January 1692, Le Clerc announced to Locke his intention to publish the pamphlet in Latin; and upon intimating this to Sir Isaac, he entreated him "to stop the translation and impression as soon as he could, for he designed to suppress them." This was accordingly done; but Le Clerc sent the manuscript to the library of the Remonstrants, and it was afterwards published at London in 1754, under the title of Two Letters from Sir Isaac Newton to M. le Clerc. This edition is imperfect, and in many places erroneous; and Dr Horsley has published a genuine one, which is in the form of a single letter to a friend, and was taken from a manuscript in Sir Isaac's own hand, in the possession of the Reverend Dr Ekins, dean of Carlisle.[1]

Sir Isaac Newton left behind him in manuscript a work entitled Observations on the Prophecies of Daniel and the Apocalypse of St John, which was published in London in 1733, in one volume 4to; another work entitled *Lexicon Propheticum*, with a dissertation on the sacred cubit of the Jews, which were printed in 1737; and Four Letters addressed to Dr Bentley, containing some arguments in proof of a Deity, which were published by Mr Cumberland, the nephew of Dr Bentley, in 1756.[2] Sir Isaac composed some other theological manuscripts which have not been published.

Sir Isaac Newton devoted much of his time to the study of chemistry; but the greater number of his experiments still remain in manuscript. His *Tabula Quantitatum et Graduum Caloris* contains a comparative scale of temperature from that of melting ice to that of a small kitchen coal fire. He wrote also another chemical paper, *De Natura Acidorum*, which has been published by Dr Horsley. Sir Isaac spent much time in the study of the writings of the alchemists; and the Rev. Mr Law informs us, that he had diligently studied the writings of Jacob Behmen, and that there were found amongst Sir Isaac's manuscripts copious abstracts from them in his own handwriting. He states also, that in the earlier part of his life he and his relation Dr Newton of Grantham had put up furnaces and had wrought for several months in quest of the philosopher's tincture. These views are rendered more probable by the fact, that in the list of Newton's manuscripts published by Dr Hutton, and in the possession of the Earl of Portsmouth, there are many sheets in Sir Isaac's hand, of Flamsteed's Explication of Hieroglyphic Figures, and in another hand many sheets of William Yworth's *Processus Mysterii Magni Philosophicus*.

Amongst the inventions of Sir Isaac Newton we must enumerate his reflecting telescope, his reflecting microscope, a sextant similar to Hadley's, and his prismatic reflector, with plane and convex surfaces. We owe also to him some very interesting views on the decussation of the optic nerves, which were first published in Harris's Optics; a hypothesis respecting ether as the cause of light and gravity; and some experiments upon the excitation of electricity on glass.[3]

The sale of the second edition of the *Principia* having been rapid, a third edition was called for in 1722. Roger Cotes had died in the prime of life, and therefore Newton engaged Dr Pemberton to superintend the new edition, which was published in 1726, with numerous alterations.

During the last twenty years of Sir Isaac's life, his beautiful and accomplished niece, Miss Catherine Barton, had managed his domestic concerns. She was the daughter of Mr Robert Barton of Brigstock, and of Hannah Smith, Newton's half sister. She had been a great favourite of Charles Montague, earl of Halifax, who, at his death in 1715, bequeathed to her a very large portion of his fortune. This lady, who had been educated at Sir Isaac's expense, married Mr Conduit, and continued to reside with her husband in Sir Isaac's house until the time of his death.

In the year 1722, when he was eighty years old, he had been seized with an incontinence of urine, which was ascribed to stone. By great attention to diet and regimen he succeeded in keeping down this dreadful malady; but in 1724 he passed a small stone, and for some months enjoyed a tolerable degree of health. In January 1725 he was seized with a violent cough and inflammation of the lungs, which induced him to reside at Kensington; and in the February of the same year he had a fit of gout both in his feet and hands, which produced a decided improvement in his general health. His duties at the Mint were discharged by Mr Conduit, and he therefore seldom went to London. Feeling himself well, he went to London on the 28th of February 1728, to preside at a meeting of the Royal Society; but the fatigue which attended this duty brought on a violent return of his former complaint, and he returned to Kensington on the 4th of March, when Dr Mead and Dr Chesselden pronounced his disease to be stone. He endured the sufferings of this complaint with wonderful patience and meekness. He seemed a little better on the 15th of March, and on the 18th he read the newspapers and conversed with Dr Mead; but at six o'clock in the evening he became insensible, and continued in that state till Monday the 20th of March, when he expired between one and two o'clock in the morning, in the eighty-fifth year of his age. His body was removed to London, and on Tuesday the 28th of March it lay in state in the Jerusalem Chamber, and was thence conveyed to Westminster Abbey, where it was buried near the entrance into the choir, on the left hand. The pall was supported by the Lord Chancellor, the Dukes of Roxburghe and Montrose, and the Earls of Pembroke, Sussex, and Macclesfield, who were fellows of the Royal Society. The Bishop of Rochester performed the funeral service. The relations who inherited his personal estate devoted L.500 to the erection of a monument to his memory. It was finished in 1731, and was erected in the centre of the abbey. The following is the epitaph inscribed upon it:

Hic situs est
Isaacus Newton, Eques auratus,
Qui animi vi prope divina
Planetarum motus, figuras,
Cometarum semitas, Oceanique Æstus
Sua Mathesi facem præferente
Primus demonstravit;
Radiorum Lucis dissimilitudines
Colorumque inde nascentium proprietates
Quas nemo antea vel suspicatus erat, pervestigavit;
Naturæ, antiquitatis, S. Scripturæ
Sedulus, sagax, fidus interpres;
Dei opt. max. majestatem philosophia asseruit;
Evangelii simplicitatem moribus expressit.
Sibi gratulentur mortales, tale tantumque extitisse,
HUMANI GENERIS DECUS
Natus xxv. Decemb. MDCXLII.; Obiit xx. Mar.
MDCCXXVII.

In the beginning of the year 1731 a medal was struck at the Tower in honour of Sir Isaac Newton, bearing the motto, *Felix cognoscere causas;* and on the 4th of February 1755 a fine full-length statue of him by Roubillac, executed in white marble, was erected in the antechapel of Trinity College, Cambridge, at the expense of Dr Robert Smith, the author of the Complete System of Optics. The pedestal bears the inscription

Qui genus humanum ingenio superavit;

an assertion which may be justly doubted, even by those who are the greatest admirers of Newton's genius.

[1] See Brewster's Life of Newton, p. 276.
[2] The original letters are preserved in the library of Trinity College, Cambridge.
[3] *Newtoni Opera*, by Horsley, vol. iv. p. 375.

Newton.

The personal estate of Sir Isaac Newton amounted to about L.32,000. It was divided amongst his four nephews and four nieces of the half blood, the grandchildren of his mother by the Rev. Mr Smith. The family estates of Woolsthorpe and Sustern were bequeathed to John Newton, whose great-grandfather was Sir Isaac's uncle, by whom they were sold in 1732 to Mr Edmund Turnor of Stoke Rocheford. Sir Isaac bequeathed his estate at Kensington to Catherine, the only daughter of Mr Conduit, who afterwards married Mr Wallop, the eldest son of Lord Lymington, and subsequently Earl of Portsmouth. Sir Isaac was succeeded as warden and master of the mint by his nephew, Mr Conduit, who died in 1737.

In his social character Sir Isaac Newton was modest, and candid, and affable, accommodating himself to every class of society in which he moved. His humility was that of a philosopher who had experienced both the strength and the weakness of the human mind, and of a Christian who was deeply impressed with the unsatisfying nature of all earthly greatness. "I do not know," said he, a short time before his death, "what I may appear to the world; but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me." His religious and moral character were equally admirable. He was deeply versed in the knowledge of the Scriptures, and was not equalled in point of theological learning by any of the divines of his age. He was a great friend of religious toleration, and never scrupled to express his abhorrence of even the mildest species of religious persecution.

Sir Isaac Newton was remarkable for his liberality upon all occasions. His charity was boundless, and he was in the habit of remarking, that those who gave away nothing till they died never gave at all. He wrote to the Provost of Edinburgh in 1724, offering L.20 annually to Mr Maclaurin, provided he became assistant to Mr James Gregory, professor of mathematics in the university. In 1719 he gave fifty guineas to the Rev. Mr Pound, who made some astronomical observations for his use; and in 1720 he gave him the like sum. He likewise bestowed large donations on the Ayscoughs, his relations.

In his personal appearance Sir Isaac was not above the middle size. He had "a comely and gracious aspect, and a very lively and piercing eye." He was short-sighted, but never wore spectacles, nor lost more than one tooth in his life. Bishop Atterbury asserts, in opposition to this, that the lively and piercing eye did not belong to Sir Isaac during the last twenty years of his life. "Indeed," says he, "in the whole air of his face and make there was nothing of that penetrating sagacity which appears in his compositions. He had something rather languid in his look and manner, which did not raise any good expectation in those who did not know him."

The manor-house of Woolsthorpe, as well as every other memorial of Sir Isaac, has been preserved with religious care. Mr Turnor of Stoke Rocheford, the proprietor, put up, in 1798, a white marble tablet in the room where Sir Isaac was born, recording his birth and death, and bearing the celebrated lines of Pope:

> Nature and Nature's laws lay hid in Night;
> God said, "Let Newton be," and all was Light.

The house still contains on its walls the two dials made by Newton himself, but without the styles. His second telescope is preserved in the library of the Royal Society; and his globe, universal ring dial, quadrant, compass, and a reflecting telescope said to have belonged to him, in the library of Trinity College, Cambridge.

Newton.

The manuscripts, correspondence, and other papers of Sir Isaac Newton, have been preserved in different collections. But the most important collection is the family one in the possession of the Earl of Portsmouth. They are deposited at Hursbourne Park, his lordship's seat in Hampshire, and have been very recently (in 1837) examined by H. A. Fellowes, Esq. the accomplished nephew of Lord Portsmouth, and by Sir David Brewster, who has been permitted to make use of them in composing Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton. In this examination much new and valuable information has been discovered relative to the early life of Sir Isaac, which had been collected by his nephew-in-law Mr Conduit, for the purpose of writing a life of him, which he was prevented from executing by his death in the year 1737. Many letters and papers of Newton are in the possession of the Earl of Macclesfield at Shirburn. They were found amongst the papers of William Jones, the friend of Sir Isaac, and the father of Sir William Jones. These papers have recently been put into the hands of Professor Rigaud of Oxford, who is now preparing them for publication.

About thirty-four of Newton's letters to Flamsteed are deposited in the library of Corpus Christi College, Oxford; but a large portion of the correspondence between Newton and Halley has recently been found by Mr Baily in the possession of Mr Giles, a private gentleman in London, and in the Royal Observatory at Greenwich, along with various important documents intimately connected with the scientific history of that period. As the papers found in the observatory had been purchased by the Board of Longitude in 1771, the lords commissioners of the admiralty, on the recommendation of the board of visitors of the Royal Observatory, agreed to print them. They have been accordingly printed in a large quarto volume, under the superintendence of Mr Baily.[1]

Doubts have been entertained by some, and openly expressed by others, relative to the propriety of publishing all the papers contained in this collection. Several of the letters of Flamsteed, and various parts of his autobiographical memoir, contain bitter and malignant attacks upon the character and conduct of Sir Isaac Newton, which, if they had been published during his life, or not long after it, might have been refuted on the authority of documentary and other evidence which cannot now be obtained. Fortunately for the memory of Sir Isaac Newton, his generous and noble character, his meek and gentle disposition, and his Christian forbearance and patience, form a secure shield against the reckless and wanton charges of his irritable and violent assailant. If reflections have been cast on the character of Newton by the animadversions of Flamsteed, the conduct of the latter has been exposed to a scrutiny which it may not be able to sustain; and the friends of Newton are reluctantly compelled to collect the opinions which contemporary writers had expressed of Flamsteed, in order to enable the public to form a just estimate of the testimony which he has borne against his fellow-labourer in science.

Those who wish to know more of the differences between Newton and Flamsteed, may consult the volume above mentioned, which is entitled An Account of the Rev. John Flamsteed, the first Astronomer Royal, compiled from his own manuscripts, and other authentic documents never before published; to which is added, his British Catalogue of Stars, corrected and enlarged, printed by order of the Lords Commissioners of the Admiralty, Lon-

[1] This volume was not published; the whole impression, which was small, being distributed in presents to scientific institutions, public libraries, and individuals interested in the subjects to which it relates.

don, 1835. Mr Baily, at his own expense, published, in January 1837, a supplement to this work, which, with his usual liberality, he "distributed amongst those persons and institutions only to whom the original work was presented." (N. N. N.)

Newtonian *Philosophy*, the doctrine of the universe, and particularly of the heavenly bodies, their laws, affections, &c. as delivered by Sir Isaac Newton.

The term *Newtonian philosophy* is applied very differently. Some authors under this denomination include all the corpuscular philosophy, considered as it now stands corrected and reformed by the discoveries and improvements made in several parts of it by Sir Isaac Newton. In this sense it is that 'sGravesande calls his elements of physics *Introductio ad Philosophiam Newtonianam*; and in this sense the Newtonian is the same with the new philosophy, standing contradistinguished from the Cartesian, the Peripatetic, and the ancient corpuscular system. By Newtonian philosophy others mean the method or order which Sir Isaac Newton observes in philosophizing, viz. the reasoning and drawing of conclusions directly from phenomena, exclusive of all previous hypotheses; the beginning from simple principles, deducing the first powers and laws of nature from a few select phenomena, and then applying those laws, &c. to account for other things. And in this sense the Newtonian philosophy is the same with the *experimental* or *inductive philosophy*, and stands opposed to the ancient corpuscular system. By this philosophy some understand that particular kind in which physical bodies are considered mathematically, and where geometry and mechanics are applied to the solution of the appearances of nature. In this sense the Newtonian is the same with the *mechanical* and *mathematical philosophy*. Others, again, by Newtonian philosophy, understand that part of physical knowledge which Sir Isaac Newton has handled, improved, and demonstrated, in his *Principia*. Lastly, by it is meant the new principles which Sir Isaac Newton has brought into philosophy, the new system founded thereon, and the new solutions of phenomena thence deduced, or that which characterizes and distinguishes his philosophy from all others; and this is the sense in which it ought to be used.

As to the history of this philosophy, we have nothing to add to what has been stated in the preceding and in other articles. It was first made public in the year 1687, by the author, then a fellow of Trinity College, Cambridge; and in the years 1713 and 1726 republished with considerable improvements. See the articles Astronomy, Attraction, Dynamics, Mechanics; Professor Playfair's Dissertation (part ii. sect. ii. p. 535); and Sir John Leslie's Dissertation (sect. vii. p. 655).

Newton, *Thomas*, lord bishop of Bristol, and dean of St Paul's, London, was born on the 1st of January 1704. His father, John Newton, was a considerable brandy and cider merchant, who having, by his industry and integrity, acquired what he thought a competent fortune, left off trade several years before he died. Young Newton received the first part of his education in the free school of Lichfield, which, the bishop observes with some kind of exultation, had at all times sent forth several persons of note or eminence, from Bishop Smaldridge and Mr Wollaston, to Dr Johnson and Mr Garrick. From Lichfield he was, in 1717, removed to Westminster School, and placed under the care of Dr Freind and Dr Nicoll. During the time he remained at Westminster, there were, he observes, more young men who afterwards made a distinguished figure in the world, than perhaps at any other period, either before or since. He particularly mentions Murray, afterwards Earl of Mansfield, with whom he lived upon terms of the greatest friendship to the close of his life. Having passed six years at Westminster School, he went to Cambridge, and entered at Trinity College, where he constantly resided eight months at least in every year, till he took his degrees in arts. Being chosen fellow of his college, he went afterwards to settle in London. As it had been his inclination from childhood, and as he was likewise designed for holy orders, he had sufficient time to prepare himself, and composed some sermons, that he might have a stock in hand when he entered on the ministry. His title for clerical orders was his fellowship; and he was ordained deacon in December 1729, and priest in the February following, by Bishop Gibson. Upon his first setting out in this office, he was curate at St George's, Hanover Square, and continued for several years assistant preacher to Dr Trebeck. His first preferment was that of reader and afternoon preacher at Grosvenor Chapel, in South Audley Street; an appointment which introduced him to the family of Lord Tyrconnel, to whose son he became tutor. He continued in this situation for many years, living much at his ease, and on terms of great intimacy and friendship with Lord and Lady Tyrconnel, "without so much," he tells us, "as an unkind word or a cool look intervening." In the spring of 1744, he was, through the interest of the Earl of Bath, his great friend and patron, presented to the rectory of St Mary le Bow; so that he was forty years of age before he obtained any living. At the commencement of the year 1745 he took his doctor's degree. In the spring of 1747 he was chosen lecturer of St George's, Hanover Square, by a most respectable vestry of noblemen and gentlemen of high distinction. In August following he married his first wife, the eldest daughter of Dr Trebeck, an unaffected, modest, decent young woman, with whom he lived happily for nearly seven years. In 1749 he published his edition of Milton's Paradise Lost, which was well received by the public, and by 1775 had gone through eight editions. After the Paradise Lost, it was judged proper that Dr Newton should likewise publish the Paradise Regained, and other poems of Milton; but these things he thought detained him from other more material studies, though he had the good fortune to gain more by them than Milton did by all his works put together. But his greatest gain consisted in their first introducing him to the friendship and intimacy of two such men as Bishop Warburton and Dr Jortin. In 1754 he lost his father, at the age of eighty-three; and within a few days his wife, at the age of thirty-eight. This was the most severe trial he ever experienced, and it almost overwhelmed him. At that time he was engaged in writing his Dissertations on the Prophecies; and in his affliction he found no better nor more effectual remedy than plunging deeply into study, and fixing his thoughts as intensely as he possibly could upon other subjects. The first volume was published the following winter, but the other did not appear till three years afterwards; and as a reward for his past and an incitement to future labours, he was in the mean time appointed to preach Boyle's lecture. The bishop himself informs us, that twelve hundred and fifty copies of the Dissertations were taken off at the first impression, and a thousand at every other edition; and "though," he adds, "some things have been since published upon the same subjects, yet they still hold up their head above water, and having gone through five editions, are again prepared for another. Abroad, too, their reception has not been unfavourable, if accounts from thence may be depended upon." They were translated into the German and Danish languages, and received the warmest encomiums from persons of learning and rank. In the spring of 1757, he was made prebendary of Westminster, in the room of Dr Green, and promoted to the deanery of Salisbury. In October following, he was made sub-almoner to his majesty, an appointment which he owed to Bishop Gilbert. In September 1761, he married a second wife, the

Newton-Stewart

widow of the Rev. Mr Hand, and daughter of Viscount Lisburn; and in the same month he kissed his majesty's hand for his bishopric. On the death of Dr Stone, the primate of Ireland, in the winter of 1764, Mr Grenville sent for Bishop Newton, and in the most obliging manner desired his acceptance of the primacy; but having maturely weighed the matter in his own mind, he declined the offer. In 1768 he was made dean of St Paul's. His ambition was now fully satisfied, and he firmly resolved never to ask for any thing more. From this time till his death his health was almost constantly infirm; indeed it is wonderful that such a poor, weak, and slender thread as the bishop's life, should have been spun out to such an amazing length as it really was. In the autumn of 1781, he laboured under repeated illnesses; and on Saturday the 9th of February 1782, his breathing began to be much affected by the frost. His complaints grew worse till the following Thursday, when he got up at five o'clock, and was placed in a chair by the fire, having suffered much in bed. About six o'clock he was left by his apothecary in a quiet sleep; between seven and eight he awoke, and appeared rather more easy, and took a little refreshment. He continued dozing till near nine, when he ordered his servant to come and dress him, and help him down stairs. As soon as he was dressed, he inquired the hour, and bade his servant open the shutter and look at the dial of St Paul's. The servant answered that the clock was about to strike nine. The bishop made an effort to take out his watch with an intent to set it, but sunk down in his chair, and expired without a sigh or the least visible emotion, his countenance still retaining the same placid appearance which was so peculiar to him when in life.

NEWTON-STEWART, a small town in the county of Wigton, and parish of Penninghame, Scotland. It extends about a mile on the right bank of the river Cree, and consists of one long street, in which is the tolbooth, and a very short one along the old road to Glenluce. It is connected with Creebridge, a village of about 220 inhabitants, in the stewartry of Kirkcudbright, by an elegant bridge of granite over the river Cree. The post-road from London to Portpatrick passes through the town. The first houses were built in 1701, and for many years the number seems to have been small. It was erected into a burgh of barony about the year 1780, by the then proprietor, under the name of Newton-Douglas; but the original name has been again assumed. About the year 1793, a cotton manufactory was established on the banks of the Cree, at an expense of L.20,000; but the speculation did not succeed, and it was eventually given up. The whole property belonging to the company was purchased in 1830 by the Earl of Galloway, who is superior of the town. Cotton weaving forms a considerable part of the trade of the place; but it has diminished much of late years. The curing of bacon has been carried on for several years back, and the amount brought by the curers has yielded from L.5000 to L.7000 annually to the inhabitants of the surrounding district. There are several tan-works, and an extensive brewery, in full operation. Vessels of from thirty-five to seventy and eighty tons registered burden, and even some of a larger size, sail up the Cree to within a mile of Newton-Stewart. Their cargoes generally consist of coals, lime, and merchants' goods. Besides the parish school, there is an endowment, called the Douglas School, for the education of the children belonging to the place. Arrangements are at present (1837) in a state of forwardness to erect a new parish church, instead of the old church, built in 1777. There are other three places of worship in the town, one belonging to the Relief body, one to the Reformed or Cameronian presbytery, and a Roman Catholic chapel. There is a weekly market held on Friday, and various cattle markets throughout the year. The population amounted in 1821 to 1774, and in 1831 to 2260.

Newty Fort

NEWTY FORT, a small fortress of Hindustan, on the western coast of the province of Concan, situated on the southern bank of a small river. Long. 73. 40. E. Lat. 15. 56. N.

NEW YEAR'S GIFTS, presents made on the first day of the new year. Nonius Marcellus refers the origin of this custom amongst the Romans to Tatius king of the Sabines, who reigned at Rome conjointly with Romulus, and who having considered as a good omen a present of some branches that had been cut in a wood consecrated to Strenia, the goddess of strength, which he received on the first day of the new year, authorized this custom afterwards, and gave to these presents the name of *strenæ*. However this may be, the Romans on that day celebrated a festival in honour of Janus, and at the same time paid their respects to Juno; but they did not pass it in idleness, lest they should become indolent during the rest of the year. They sent presents to one another, of figs, dates, honey, and other things, to show their friends that they wished them a happy and agreeable life. Clients, that is to say, those who were under the protection of the great, carried presents of this kind to their patrons, adding to them a small piece of silver. Under Augustus, the senate, the knights, and the people presented such gifts to the emperor, and in his absence deposited them in the Capitol. Of the succeeding princes, some adopted this custom and others abolished it; but it always continued amongst the people. The early Christians condemned it, because it appeared to be a relic of paganism and a species of superstition; but when it began to have no other object than that of serving as a mark of benevolence and esteem, the church ceased to disapprove of it.

New York

NEW YORK, one of the thirteen original states of the North American confederacy, and the most populous and important in the Union. It is bounded on the north by Upper and Lower Canada; on the east by the states of Vermont, Massachusetts, and Connecticut; on the south-east by the Atlantic Ocean; on the south by New Jersey and Pennsylvania; on the west by Pennsylvania, Lake Erie, and the Niagara River; and on the north-west by Lake Ontario and the river St Lawrence. The territory of New York is situated between latitude 40. 30. and 45. north, and between longitude 5. 5. east, and 2. 55. west from the city of Washington. Its extreme length from east to west is about 340 miles, and, including Long Island, 408 miles; and its greatest breadth from north to south is 310 miles, its area being about 46,000 square miles. This estimate includes the whole surface, except the waters of the great lakes.

Physical aspect.

New York is an epitome of all configurations of surface, and every variety of lake, mountain, and river scenery. It may be described, generally, as an elevated tract, with indentations in various parts below its usual level. The most striking depressions are the great basins in which are situated Lakes Erie and Ontario, and the long narrow valley which contains the Hudson River and Lake Champlain. The two latter are united by a valley occupied by the Mohawk River and Lake Oneida. The south-eastern angle of the state, about forty miles above the city of New York, is mountainous, being traversed by several ridges from New Jersey, one of which crosses the Hudson in the vicinity of West Point, and forms the high lands of that river. It also constitutes the dividing ridge between the Hudson and the Connecticut, and lies partly in the state of Connecticut. The space south of the Mohawk River and the Ontario Valley, and between the River Hudson and Lake Erie, is occupied by another mountainous district, the western part of which forms a table-land having 2000 feet of mean elevation, and is the source of several large rivers, New York. particularly the Alleghany, the Susquehannah, and the Genesee. The eastern part, lying between Lake Seneca and the Hudson, is occupied by several parallel mountain ridges, which may be considered as continuations of the Alleghany ridge passing out from Pennsylvania. These ridges run in a north and south direction, and their indentations give rise to several fertile valleys. The highest are the Catskill Mountains, which bound the valley of the Hudson on the west. Round Top, the most elevated summit, is 3804 feet above the level of the tide-water of the Hudson. There is also a narrow table-land in this subdivision, situated a little south of the line of the Erie Canal, and continuing almost uninterruptedly from the Catskill Mountains to the head of Seneca Lake. On this elevation are situated a number of lakes, the height of which above tide-water varies from 380 to 1200 feet. A third mountain district is situated to the north of the Mohawk, between Lake Champlain and the east end of Lake Ontario. This division is traversed by at least five or six parallel ridges, passing in a north-eastern direction, and which are considered as continuations of the Appalachian chain. The highest elevation that has been ascertained with accuracy is a peak belonging to the ridge that passes through Herkimer and Hamilton counties, and the northern part of Essex, near the sources of the Hudson. It is 2686 feet above the level of the sea.

Basins, lakes and rivers.

We have already mentioned the basins in which are situated Lakes Erie and Ontario, and the valley which contains the Hudson River and Lake Champlain. The two former depressions are portions of the vast St Lawrence basin, which embraces the whole of the five great western lakes. Proceeding along the basin of the Ontario, we pass through a series of fertile counties, constituting the slope, watered by numerous rivers, which all finally terminate in the lake. The Genesee, Oswego, and Black are important streams, which rise in the interior of the state. The first-named river is the outlet of the Canesus, Hemlock, and Honeyoe Lakes. The Oswego, and its tributaries the Clyde and Seneca, convey the waters of Canandaigua, Crooked, Seneca, Cayuga, Owasco, Skaneateles, Onondaga, and Oneida Lakes into Lake Ontario. The Mohawk River occupies the eastern termination of this basin; whilst towards the north-east the slope towards the St Lawrence, indicated by the course of the Grass, Racket, Oswegatchie, and St Regis Rivers, shows it to be a continuation of that towards the lakes. The Hudson and Champlain Valley stretches nearly north and south, and is remarkable for its depth below the general surface of the level of the adjoining country. In the northern part are situated Lakes George and Champlain, which are connected with each other. The southern portion communicates with the valley of the Mohawk, which enters it in a south-easterly direction. The Hudson rises in the northern part of New York, between Lake Champlain and the St Lawrence, and has its whole course in the state. An American writer on geography thus describes this river:—"No fact in the topography of the state of New York is more remarkable than the peculiar position of the Hudson and its branches. If we trace the course of any Atlantic river south of it, we shall find the navigation closed by the mountain chain on the west. Not so with the Hudson. It penetrates the high lands, and after passing up some hundred and sixty miles, it is met by a tributary, the sources of which reach nearly to the lakes. Here the happy conformity of the country is such as to permit the establishment of an artificial navigation." After a course of between three and four hundred miles, the Hudson falls into the Bay of New York, above which it is navigable for ships about one hundred and thirty miles. The Susquehannah rises in this state, and passes into Pennsylvania, as does also the Delaware. The Alleghany of the Ohio collects its head waters in the south-west angle of this state, and passes through its noble pine-forests into Pennsylvania. Here are a vast number of lakes and streams besides those named, which would be conspicuous in a state of smaller dimensions, and where the configuration is on a less gigantic scale. But we have preferred presenting general views of the conformation of the face of the country to a dry catalogue of lakes and rivers and mountains, with their courses and terminations. Those which are remarkable for their size or peculiarities will be found more particularly described under their respective designations. Some celebrated mineral springs exist in this state. Those of Saratoga and Ballston are more resorted to than any others in the United States. The Ballston springs are situated in a valley formed by a small creek. There are a great number of them, the strongest and most sparkling waters being those obtained in 1827, by boring 227 feet down. The principal efficacy of the water arises from a chemical union of chalybeate and saline ingredients held in solution, and the presence of uncommon quantities of carbonic acid gas. Saratoga springs are several miles distant from those of Ballston, and belong to the same class of mineral waters. A large and compact village has sprung up at this place, in consequence of the immense resort to it from all parts of the United States, Canada, and even the West Indies. Saratoga springs are thirty-two miles north of Albany. To these may be added the tepid springs of New Lebanon, twenty-nine miles east of Albany, which are frequented for bathing, and on account of their cool and elevated position; and the sulphur springs of Avon; to all which places crowds of fashionable people and invalids resort during the summer months.

Geology.

Most of the formations discriminated in works of geology exist in this state, and some of them are of a very interesting character, particularly the earth and gypsum found in the western part of the state. Granite, slate, and limestone hills occur; and one species of impure limestone, found in the western and northern parts of New York, has been used with great success in the construction of canals. Marble has been obtained in large quantities, for architectural purposes, from the quarries of Sing Sing. Its purity is said to increase with the depth of the excavations, and several large and beautiful public edifices have been constructed of it. At the head of Lake Onondaga are situated salt springs of the same name, surrounded by the waters of the lake, which still, however, continue perfectly fresh. Plants peculiar to the sea-coast are found here, in particular the *salicornia* and *salsola.* Underneath the mud or decayed vegetable matter which constitutes the valley of these springs, a stratum of earthy marl is found, containing numerous fossil univalves; and this again appears to be succeeded by a conglomerate. The peculiar nature of the underlying rock, or rather its position, does not seem to be determined. Great quantities of salt are manufactured here by the various processes of boiling and solar evaporation. Gypsum, in its various forms of earthy gypsum, selenite, and even alabaster, is found, particularly in the counties of Onondaga and Cayuga, and is extensively used for agricultural purposes. Another prominent article of mineral wealth is iron ore, immense beds of which are found in the counties west of Lake Champlain. The iron ore of Columbia county is likewise highly valued and extensively manufactured. Lead, silver, zinc, titanium, and other metals, have been detected in various parts of the state; and anthracite or bituminous coal is found, but it is questionable whether in sufficient quantities to afford remuneration for the expenses of mining. Petroleum, porcelain clay, and most of the fossils, are found in different places, and some of the organic remains discovered belong to the higher animals. Transition and secondary rocks compose the body of the state; and in the granitic dis-

New York. tricts, near New York, and on the borders of Lake Champlain, picturesque and remarkable projections of rock, caverns, and the like, frequently occur. The cataracts and smaller falls of water are numerous in this state; and those of Niagara are the most magnificent in the world. Cohoes is a fine fall on the Mohawk River, having seventy feet of perpendicular descent. The Little Falls on the same river present most beautiful scenery; and amongst the remarkable objects connected with the artificial navigation of New York, may be mentioned the aqueduct at Little Falls, that over the Genesee at Rochester, and the locks at Lockport, at Little Falls, and at the junction of the northern and western canals. Glen's Falls on the Hudson, and those on the Genesee in the village of Rochester, and at Ithaca, also deserve mention as very striking cascades, but only too near Niagara to be famous. A limestone cavern of vast dimensions, with its falls, columns, and stalactites, exists on the banks of Black River, opposite Waterton. The ridge road, extending from Rochester to Lewiston, is a most remarkable geological formation. As its name implies, it is a natural road of sufficient width for the purposes of travelling, and generally is extremely level. It runs nearly parallel with the shores of Lake Ontario, from which it is distant sometimes several miles. There is a remarkable natural production of carburetted hydrogen in the towns of Fredonia and Portland, Chautauque county. This gas is obtained in such immense quantities that it has been conducted into these villages, and used as a natural gas-light. In the western part of this state are situated the hunting grounds and residences of the famous six Indian nations, who have now submitted to the restraints of civilization; and these are adorned by the productions of industry and refinement, yet still show traces of their former existence in the mounds and other antiquities occasionally observed.

Islands. There are several islands belonging to the state of New York. Long Island, as its name imports, is a long but narrow strip of insular land, extending east from the city of New York one hundred and fifty miles, forming a curve parallel to the mainland shore, and leaving a broad and beautiful sheet of water not unlike a wide river between, called Long Island Sound. It contains three counties, the chief towns being Brooklyn, Jamaica, Sag Harbour, and Flatbush. The south border is a long belt of sand, somewhat barren; but the northern has a fertile soil, and is in a high state of cultivation, producing large quantities of grain, fruits, and hay. Like other insular positions, it has a climate more mild than that of the adjacent continent. Sag Harbour is the principal port. New York is in a great measure supplied with wood from this island, the eastern part of it being remarkably well adapted to its growth. On the west, Long Island is divided from Staten Island by the narrows, and from Manhattan Island by East River. On the latter island is situated the city of New York, which will be afterwards described. Staten Island is above fourteen miles in length by from five to eight in breadth, and is the most southern land belonging to New York.

Soil, climate, and productions. In the maritime belt of the state the soil is sandy; in the middle it is a finely undulating and productive country; and in the western and southern divisions it is remarkably level, rich, and inclining to alluvial formation. The state has a great proportion of first-rate land. The country on the Hudson, below the mouth of the Mohawk, has a good medium soil. The counties of Westchester and Dutchess are under very good cultivation. The alluvial flats of Columbia and Rensselaer are very extensive and rich. A considerable district west of Albany consists of sandy plains interspersed with marshes. The alluvial flats upon the Mohawk are large and extremely fertile. The soil of the elevated plain of the western region, being occupied by the small lakes, is a rich mould equally well adapted to grain and grass. The alluvial flats are here extensive; those on the Mohawk comprise about 60,000 acres. With regard to climate, a general view can scarcely be given of a country which stretches over four degrees and a half of latitude. In the northern division, which abuts upon Canada, the climate, as might be expected, is somewhat severe, partaking of the nature of these northern regions. In the south-east, towards the sea, it is temperate, but subject to sudden and great changes. As the eastern boundary of New York passes along the borders of the states of Connecticut, Massachusetts, and Vermont, the climate of these parts resembles that of the states to which they are contiguous. After passing the high lands, and entering into the eastern country beyond Utica, the climate becomes milder than it is to the eastward. In the western parts, contiguous to Lakes Ontario and Erie, the temperature is moderated by these waters, and does not reach the same extremes as in the south-east. The climate of the whole state is in general healthy, and favourable to cultivation. A mass of interesting facts regarding temperature has been obtained, in consequence of the regents requiring annual meteorological reports from the academies under their care. These academies are scattered over every part of the state, and the mean temperature of the whole thus furnishes an approximation towards that of the state generally.

In 1826, the mean temperature of ten places reporting complete annual tables was	49·38
In 1827, the mean temperature of 18 places was	46·48
In 1828, the mean temperature of 24 places was	49·50
In 1829, the mean temperature of 28 places was	46·45
In 1830, the mean temperature of 34 places was	48·15
Mean of the five years	48·00

The quantity of rain and snow has also been ascertained in a similar manner. Thus:

In 1826, the mean rain and snow of nine places was	36·34
In 1827, the mean rain and snow of 17 places was	44·29
In 1828, the mean rain and snow of 25 places was	36·74
In 1829, the mean rain and snow of 25 places was	34·88
In 1830, the mean rain and snow of 32 places was	38·86
Mean of the five years	38·22

The highest degree of temperature noticed in these tables is 104°, at which the thermometer stood in an academy in the county of Orange, on the 20th of July 1830. It is situated in lat. 41. 32. north, and long. 74. 10. west. The lowest degree noticed is — 33, at which the thermometer stood in an academy in the county of Lewis, on the 31st of January 1830. It is situated in lat. 43. 47. north, and long. 75. 33. west. The range of the thermometer in New York state is therefore 137 degrees of Fahrenheit. It is rarely lower than — 33; but on the 4th of January 1835, it fell forty degrees below zero at New Lebanon. This, however, is an extreme case. The scale of variation in summer may be given at from 35° to 60°, in autumn at from 60° to 73°, in winter at from 70° above to 26° below zero, and in spring at from 3° to 75°. The variation is greatest upon the Atlantic coast, along the St Lawrence, and around Lakes Ontario and Erie; the north-east, east, south-east, and south-west winds being more prevalent upon the coast, and the north-east and south-west upon these lakes and along the St Lawrence. The variations of the weather at all seasons are great and sudden, changing the temperature in a few hours 40° or 50°, rising with the southerly, and diminishing with the northerly winds.

Productions. The staple productions of New York consist principally of wheat and other grain, flour, flax, hemp, provisions, salt, pot and pearl ashes, and lumber. The forest trees, which thrive to the greatest advantage in an alluvial soil, are common in the western divisions of this state, and at-

New York. tain a large size. Wheat, however, is considered as the grand staple of New York.

The great wheat district of the state commences in the valley of the Mohawk, above the primitive spur at Little Falls, in a fertile soil of calcareous alluvion, which overspreads the valley at German Flats. This district, comprehending the central portions of Oneida county, extends westward to the lakes, and is bounded northwards by the north ridge of the valley, by Lake Ontario, and southwards by a line running south-west from Utica to the mouth of Cattaraugus Creek at Lake Erie. This is the garden of the state, including the rich Seneca vale, and the far-famed Genesee county. Some portions of this district are sandy, and in others the rock rises too near the surface, whilst others are not sufficiently watered; but taken as a whole, it is not surpassed by any district of equal extent in the United States. Here artificial manures are rarely used, and indeed rarely needed. In the newly-cleared lands, the richness of the mould and of the sub-soil is all that the farmer requires, being content if, by clearing away the forest, he can only bring it forth. Amongst the obstructions which the stumps of the trees offer, he is compelled to plough as he can, not as his judgment might dictate. In tracts long cleared, deep ploughing, blending the mould and the soil, preserves the former, and turns up the latter to disintegrate, and thus to yield its calcareous matter. Upon such farms some attention is given to rotation in crops, with a view to the preservation of fertility; but it is not uncommon to find the same field sown in wheat for a series of years, without the intervention of other crops. Taking the whole district together, the average product of wheat may be from twenty-five to thirty bushels the acre; but from forty to fifty are frequently obtained. Instances have been known of more than eighty bushels to the acre, and of Indian corn one hundred and twenty-five. The apple, pear, cherry, and quince, all thrive admirably; and the peach in size and flavour is scarcely inferior to that of the Atlantic coast. Grapes also, both foreign and indigenous, richly repay careful cultivation.

The region south of the line above drawn, and north of the southern boundary of the state, and between Lake Erie and that portion of the Kaatsbergs which runs parallel with the Hudson, may be characterized as a grazing country. Upon its northern border, the limestone, being more abundant than in other parts, renders the soil more or less productive in wheat; and this section, producing grain and grass abundantly, is by many preferred to that which is most fertile in wheat. By far the larger portion of this south-western district is yet covered with forests, and in most places upon its southern borders, the chief business of its inhabitants consists in the cutting and vending of lumber, consequently its agricultural products are inconsiderable compared with its population. There are, however, some well cultivated tracts in all the border counties, and in Chautauque, upon the shores of Lake Erie. One of the most useful improvements introduced into agriculture, and the result partly of experience, partly of the necessity imposed by the opening of the eastern markets to the western region, is the appropriation of soils exclusively to the productions for which they are by nature adapted, and the consequent abandonment of the practice of endeavouring to compel every species to yield crops to which it is not congenial. Under this wise system much of the country upon the North River has ceased to be a grain district. Large portions of it are devoted to horticulture, for supplying culinary vegetables to the greatly increasing population of the cities and numerous villages; and those portions of the district most remote from markets are being rapidly converted into pasturage. Thus the comparatively sterile soil of Long Island and Westchester is profitably devoted to the production of garden and field esculents, fruit, hay, oats, and small meats, for the great market of the city, in the proximity of which the cultivator finds ample compensation for the inferiority of soil, and the consequent greater cost of production, his lands being by this circumstance, and the facility of obtaining manures, rendered more valuable than the naturally rich fields of the west. Thus, too, the high and hilly grounds of Putnam county have, by the free use of gypsum, been made very productive pastures, in which the plough is comparatively little used, and which maintain large droves of cattle and sheep, but chiefly of the former. The counties of Dutchess, Columbia, and Washington, especially the two first, comprising considerable portions of limestone soil, alternating with slate, produce profitable crops of wheat. But the eastern and northern portions of Dutchess, and the hilly sections of Columbia, are chiefly laid out in sheep farms, and in Washington the raising of sheep is rapidly becoming the staple business. In Orange county the chief products are those of the dairy, and the butter of this county has long been held in the highest estimation. The raising of sheep also extends rapidly here. Ulster and Greene counties likewise produce large quantities of cattle and sheep, and, of late years, of butter and hay for export. The portions of Albany and Saratoga counties which are not covered with sand, and the portion of the latter not included in the primitive mountains, are under good cultivation. Wheat is not unprofitable, and Albany exports large quantities. Still the best returns are obtained from cattle and sheep. The northern counties of Warren, Essex, and Clinton, can boast but little of their agriculture; yet the primitive virgin mould is scarcely anywhere exhausted, and the forest trees grow thickly and to a large size. The abundance of timber, and the facility of getting it to market, together with the rich mineral deposits, have hitherto chiefly occupied the attention of the inhabitants. The northern portions of Franklin and St Lawrence counties, very partially cleared, and level or gently undulating, are well adapted for cultivation. No parts of the state yield better grass, and the raising of cattle and sheep is found to be the most profitable employment of the soil, although it is well adapted to wheat, Indian corn, and other grains. Jefferson county is very productive of wheat, as are other parts of New York, which, however, do not require to be specially mentioned. Societies have been formed in various parts of the state for the promotion of agriculture and horticulture, and they have already been productive of much good.

Antiquities. The line of extraordinary works, supposed to have been of a military character, which may be traced from the shores of Lake Ontario as far as the valley of the Mississippi, and thence southward to an indefinite extent, must not be overlooked in our survey of the surface of this state. These works consist of earthen parapets, the sites of which, with a view to defence, appear to have been selected with much judgment, and upon the construction of these greater skill has been exercised than any displayed by the Indian races known to us. The erection of these fortifications has been ascribed to the European nations, French and Spanish, who, at periods immediately subsequent to the discovery of America, visited its shores, and also to a race of inhabitants supposed to have preceded that found there by the Europeans. The works themselves afford no means of tracing their origin, but they display indubitable marks of high antiquity, so that the opinion of their having been constructed by the French or the Spaniards is at once exploded. The forms of these remains are various, being circular, elliptical, triangular, and square; and they are generally placed in situations which command the adjacent country. Near many of the forts are mounds of earth raised for cemeteries, in which human bones in various stages of decay have been discovered. The number of forts and mounds situated in

New York. the western parts of this state much exceeds an hundred. The enclosed areas of the fortifications vary from six acres to one hundred feet in diameter; and the earthen walls which enclose them, in their present abraded condition, are from ten to twelve feet in height, and from six to eight feet in breadth. Some of these breast-works bear or have borne trees, whose age has been estimated at more than two hundred and seventy-five years, and which may have been preceded by others. One fact seems to indicate that the architects were not greatly advanced in civilization. In the remnants of manufactured articles found, there is an absence of any finished works of art in wood or metals, and the fragments of pottery are rude and of a primitive form. They are therefore in all likelihood not the production of the Toltecs or the Aztecs who found their way to Mexico over the northern parts of the continent, but must be attributed to the Alligewi or some other Indian tribe.

About twenty-five years ago, this state commenced a system of internal improvement, which has been prosecuted on an extensive scale, and with great success. The enterprise of this nature which was first undertaken is the Erie Canal, one of the greatest and most important works of the kind in the world. It was begun on the 4th of July 1817, and was completed in 1825. The principal canals in New York, with the exception of the Hudson and Delaware Canal, have been constructed by the state, and are now its property. But the railroads have been mostly undertaken by incorporated companies. The railroad first undertaken in the state was the Mohawk and Hudson Railroad, which was begun in 1830, and finished in 1833. Since that time several railroads have been completed, more are in progress, and a still greater number are projected. For details as to the extent of inland navigation in the state of New York, see the article NAVIGATION, INLAND.

New York. Canals.

The following table shows the number of railroads which have been completed.

Names.	From	To	Completed.	Length in Miles.
Buffalo and Black Rock	Buffalo	Black Rock	1835	3
Ithaca and Oswego	Ithaca	Oswego	1834	29
Mohawk and Hudson	Albany	Schenectady	1832	16
Rensselaer and Saratoga	Troy	Ballston Spa	1835	24½
Rochester	Rochester	Carthage	1833	3
Saratoga and Schenectady	Saratoga Springs	Schenectady	1832	22
Utica and Schenectady	Utica	Schenectady	1836	77
		Total		174½

The railroads which have been commenced are the following:

Names.	From	To	Length in Miles.
Auburn and Syracuse	Auburn	Syracuse	26
Buffalo and Niagara	Buffalo	Niagara Falls	21
Catskill and Canajoharie	Catskill	Canajoharie	68
Haerlem	Prince St. N. Y.	Haerlem	7
Hudson and Berkshire	Hudson	Massachusetts line	30
Lockport and Niagara	Lockport	Niagara Falls	24
Long Island	Brooklyn	Greenport	98
New York and Erie	New York city	Lake Erie	505
Saratoga and Washington	Saratoga Springs	Whitehall	41
Tonawanta	Rochester	Attica	45
		Total	865

The New York and Erie Railroad, one of the greatest works of the kind that has ever been projected, extending from the city of New York, through the southern counties of the state, to Portland and Dunkirk on Lake Erie, was commenced in November 1835. The total expense of this vast undertaking is estimated at 2,717,518 dollars. Up to the end of 1834 there had been forty other railroad companies incorporated, having a capital of thirty-five millions of dollars; and in the session of 1836 there were no less than forty-two incorporated. One of these, the Utica and Syracuse Railroad, above fifty miles in length, and several others, have either commenced very lately, or are now (1837) about to commence.

The following tables present so complete a view of the actual state of New York as to render any detailed description unnecessary.

Census of the Population of the State in 1830 *and* 1835.[1]

Counties.	Towns.	Population in 1830.	Population in 1835.	Male Aliens.	Paupers.	Coloured not Taxed.
Albany	10	53,520	59,762	3,381	339	1,187
Alleghany	28	26,276	35,214	143	38	118
Broome	11	17,579	20,190	426	38	128
Cattaraugus	23	16,724	24,986	141	35	32
Cayuga	22	47,948	49,202	548	85	298
Chautauque	24	34,671	44,869	400	15	109
Chenango	19	37,238	40,762	1,170	12	244
Clinton	8	19,344	20,742	1,996	72	65
Columbia	18	39,907	40,746	553	166	1,469
Cortland	11	23,791	24,168	85	50	61
Delaware	18	33,024	34,192	475	69	135
Dutchess	18	50,926	50,704	960	189	2,071
Erie	17	35,719	57,594	5,172	63	452
Essex	15	19,287	20,699	625	60	26
Franklin	12	11,312	12,501	1,009	43	11
Genesee	24	52,147	58,588	978	83	59
Greene	11	29,525	30,173	633	154	971
Hamilton	4	1,324	1,654	...	...	...
Herkimer	18	35,869	36,201	1,024	62	228
Jefferson	19	48,515	53,080	1,712	89	125
King's	6	20,535	32,057	3,414	238	1,897
Lewis	11	14,958	16,093	604	27	61
Livingston	12	27,719	31,092	554	42	133
Madison	13	39,037	41,741	1,653	2	245
Monroe	17	49,862	58,085	2,484	88	505
Montgomery	16	43,595	46,705	1,285	126	549
New York	1	202,589	270,089	27,669	1,799	14,977
Niagara	11	18,485	26,490	973	38	141
Oneida	26	71,326	77,518	4,196	179	458
Onondaga	18	58,974	60,908	1,323	127	385
Ontario	14	40,167	40,870	697	71	526
Orange	14	45,366	45,096	1,265	209	2,098
Orleans	8	18,773	22,893	333	20	52
Oswego	20	27,104	38,245	1,381	34	160
Otsego	22	51,372	50,428	534	94	218
Putnam	5	12,628	11,551	67	68	124
Queen's	6	22,460	25,130	636	571	2,727
Rensselaer	14	49,424	55,515	2,081	182	977
Richmond	4	7,082	7,691	294	16	407
Rockland	4	9,388	9,696	280	51	415
Saratoga	20	38,679	38,012	2,459	53	56
Schenectady	6	12,347	16,230	861	160	488
Schoharie	10	27,902	28,508	728	60	410
Seneca	10	21,041	22,627	101	97	474
St Lawrence	24	36,354	42,047	323	47	154
Steuben	24	33,851	41,435	267	62	278
Suffolk	9	26,780	28,274	225	101	2,068
Sullivan	9	12,364	13,755	219	21	112
Tioga	19	27,690	33,999	143	38	189
Tompkins	10	36,545	38,008	256	6	246
Ulster	14	36,550	39,960	659	137	1,384
Warren	9	11,796	12,034	104	36	34
Washington	17	42,635	39,326	924	94	324
Wayne	15	33,643	37,788	684	6	154
Westchester	21	36,456	38,790	1,047	216	1,513
Yates	8	19,009	19,796	165	43	118
Total	797	1,919,132	2,174,517	82,319	6,821	42,836

[1] From Williams's New York State Register. In 1820 there were ten thousand slaves in New York, but slavery is now abolished in the state. New York has thus set an example which might be creditably followed by the other slave-holding states.

New York.

Aggregate Valuations of Real and Personal Estate in the several Counties of this State; also the Number of Acres of Land assessed in each County, the Amount of Town and County Taxes, and the Rate of Taxation on each Dollar of the assessed Valuation, for 1835.

Counties.	Acres of Land.	Value of Real Estate.	Value of Personal Estate.	Amount of County Taxes.	Amount of Town Taxes.	Rate of County and Town Tax upon one Dollar of Valuation.
		Dollars.	Dollars.	Dollars.	Dollars.	Mills. Fr.
Albany	297,351	9,050,370	4,440,536	41,000·07	47,398·72	6·100
Alleghany	758,380	2,414,359	100,989	12,147·22	12,288·87	...
Broome	401,404	1,752,027	268,515	7,146·99	4,035·70	5·640
Cattaraugus	788,305	1,439,725	29,968	9,834·22	11,849·73	14·200
Cayuga	414,678	3,516,028	927,146	17,706·42	5,980·65	...
Chautauque	650,620	2,948,159	208,878	15,086·70	11,659·70	8·000
Chenango	514,800	3,299,660	515,392	6,854·73	8,440·18	...
Clinton	596,800	1,359,950	68,150	8,060·55	5,525·38	15·000
Columbia	399,500	8,469,876	1,806,094	...	...	...
Cortland	299,000	2,014,093	298,507	5,451·80	5,203·36	4·800
Delaware	847,692	2,858,990	303,387	6,004·03	6,763·75	4·360
Dutchess	485,257	13,789,484	4,005,183	28,783·09	10,852·92	2·300
Erie	560,566	5,938,400	2,640,187	23,772·57	18,088·28	8·610
Essex	744,002	1,383,602	167,986	7,175·43	5,567·86	...
Franklin	977,388	862,000	59,709	5,999·96	6,326·30	14·500
Genesee	625,280	8,839,263	647,678	20,420·36	13,576·09	...
Greene	359,586	2,719,831	607,117	12,626·73	6,504·76	6·360
Herkimer	877,000	4,301,801	859,826	12,469·07	...	...
Jefferson	720,574	4,279,100	533,964	12,353·22	12,736·35	5·080
King's	26,954	28,020,644	3,920,288	28,280·00	39,090·93	1·500
Lewis	718,265	1,402,793	188,529	3,293·72	5,902·78	7·917
Livingston	316,251	4,865,524	521,915	8,708·55	7,676·47	3·000
Madison	377,309	4,392,497	601,745	11,018·69	7,414·83	3·690
Monroe	392,982	8,965,694	1,213,630	24,163·10	12,596·88	4·220
Montgomery	1,227,712	3,578,807	674,899	19,289·66	13,023·00	...
New York	14,000	143,732,425	74,991,278	577,500·00	518,494·00	4·500
Niagara	308,662	4,733,924	211,810	10,123·60	6,122·96	4·118
Oneida	704,740	9,176,167	1,926,901	22,930·00	15,143·38	4·340
Onondaga	455,100	9,427,938	1,162,036	23,094·00	18,609·55	4·012
Ontario	395,111	11,386,629	1,784,401	17,850·00	10,035·70	1·810
Orange	525,042	8,567,133	1,661,436	20,000·00	11,282·66	3·200
Orleans	238,154	4,178,166	259,658	9,283·70	6,534·16	3·900
Oswego	580,978	4,308,000	432,020	12,775·25	12,852·68	5·530
Otsego	589,302	4,788,285	1,009,714	10,967·11	8,659·62	3·500
Putnam	135,352	1,970,901	364,835	3,150·00	1,961·54	2·297
Queen's	137,178	6,531,850	2,438,650	5,897·30	6,601·67	1·700
Rensselaer	400,106	7,070,537	3,350,957	32,000·00	8,909·39	...
Richmond	28,072	800,783	95,917	2,053·00	1,914·03	...
Rockland	96,418	1,504,214	354,287	2,840·59	4,6825·3	4·600
Saratoga	502,077	5,405,468	970,662	12,800·00	7,814·72	3·750
Schenectady	119,494	1,815,623	578,222	8,650·00	5,671·21	5·900
Schoharie	353,279	1,990,000	188,344	5,558·08	4,365·61	...
Seneca	197,550	3,631,036	732,995	6,531·03	11,249·46	...
St Lawrence	1,738,500	2,691,208	233,022	12,092·81	15,274·24	1·171
Steuben	897,000	2,839,180	263,019	13,553·97	11,146·03	8·091
Suffolk	379,736	4,141,125	927,722	3,379·22	7,890·93	2·000
Sullivan	577,000	1,196,136	58,894	4,651·80	4,127·84	7·000
Tioga	625,111	2,678,381	454,696	7,410·83	7,256·94	5·200
Tompkins	371,400	3,002,450	612,349	7,753·96	2,207·54	2·940
Ulster	645,369	4,457,240	611,130	16,100·00	13,119·10	5·630
Warren	513,290	889,398	43,452	4,713·83	3,342·49	8·700
Washington	486,083	4,974,345	886,981	14,633·38	9,265·94	4·105
Wayne	375,576	3,393,465	234,000	8,000·00	7,668·26	...
Westchester	280,432	7,768,979	2,324,693	15,026·08	7,967·73	2·200
Yates	204,414	2,005,922	284,395	9,500·00	4,000·75	...
Total	27,324,232	403,517,585	125,058,794	1,246,314·42	1,032,976·15	5·011

New York.

Comparative View of the Census of the State of New York in 1825 *and* 1835.

	1825.	1835.
Whole number of souls	1,616,458	2,174,517
Males	822,897	1,102,658
Females	793,561	1,071,859
Male aliens[1]	...	82,319
Total of aliens	40,430	...
Paupers[2]	5,610	6,821
Persons of colour not taxed	38,770	42,836
Ditto taxed	931	934
Ditto qualified to vote	298	578
Persons subject to militia duty	180,645	201,901
Ditto qualified to vote	296,132	422,034
Deaf and dumb persons	645	933
Of whom supported by charity	141	278
Blind persons	...	889
Of whom supported by charity	...	270
Idiots	1,421	1,484
Of whom supported by charity	442	514
Lunatics	819	967
Of whom supported by charity	184	382
Married females under 45 years	200,481	283,230
Unmarried ditto between 16 and 45	135,391	195,499
Ditto ditto under sixteen	361,624	456,224
Marriages the year preceding	11,553	15,535
Births, male 39,839, female 37,403	60,383	77,244
Deaths, male 17,486, female 15,280	22,544	32,726
Agricultural Statistics.		
Acres of improved land	7,160,967	9,655,426
Neat cattle	1,513,421	1,885,771
Horses	349,628	524,895
Sheep	3,496,539	4,261,765
Hogs	1,467,573	1,554,358

Summary of Manufactures in the State according to the Census of 1835.

	Number.	Value of Raw Materials used and manufactured.	Value of Manufactured Articles.
		Dollars.	Dollars.
Grist mills	2051	17,687,009	20,140,435
Saw ditto	6948	3,651,153	6,881,055
Oil ditto	71	214,813	275,574
Fulling ditto	965	1,994,491	2,894,096
Carding machines	1061	2,179,414	2,651,638
Cotton factories	111	1,630,352	3,030,709
Woollen ditto	234	1,450,825	2,433,192
Iron works	293	2,366,065	4,349,949
Trip hammers	141	168,896	363,581
Distilleries	337	2,278,420	3,098,042
Asheries	693	434,394	726,418
Glass factories	13	163,312	448,559
Rope ditto	63	664,394	980,083
Chain cable ditto	2	20,871	28,625
Oil cloth ditto	24	63,119	95,646
Dyeing and printing do.	15	1,999,000	2,465,600
Clover mills	69	95,693	110,025
Paper ditto	70	358,857	685,784
Tanneries	412	3,563,592	5,598,626
Breweries	94	916.252	1,381,446

The manufactures of this state being of great importance, a detailed account of some of them is therefore necessary. Leather is a most important article of manufacture, and it is made cheaper in this state than it can be, of equal quality, in any other part of the world. The increase in the making of sole leather is 500 or 600 per cent. since 1817, and 200 or 300 per cent. since 1827. It is estimated that above one third of the whole sole leather used annually in the United States is made in New York. Above 16,000 individuals are employed and sustained by the cotton factories, which are located as follows, viz. in Oneida county twenty mills; in Rensselaer county fifteen mills; in Dutchess county twelve mills; in Otsego county eleven mills; in Columbia county seven mills; and in Westchester, Washington, and Herkimer counties, five each. Several other counties have from one to four mills each. In estimating the value of woollens made in this state, it should be borne in mind, that notwithstanding the numerous fixed establishments for the manufacture of this article, household or family manufactures of wool and cotton are still carried on to a great extent. By the state census of 1825, the following articles were made in families during the preceding year.

	Value per Yard.	Amount, Doll.
2,918,233 yards of fulled cloth	1 dollar	2,918,233
3,468,000 yards flannel and other woollens not fulled	0·20 cents	693,600
8,079,992 linen, cotton, and other cloths	0·15 cents	1,211,998

In 1835, Mr Pitkins reckoned that woollens alone were manufactured in families to the amount of at least 4,500,000 dollars annually. Now, if we allow the manufacture of linen, cotton, and other cloths, to have risen to 1,500,000 dollars, which is a fair estimate, this will make the total amount of domestic articles made in families six millions of dollars.

The following are some of the other manufactures of New York, not included in the general summary, namely, wool and fur hats made and finished in this state, estimated at 3,500,000 dollars annually; boots and shoes, deducting leather, 3,000,000 dollars annually; leather, cloth, and fur caps, probably 2,000,000 dollars annually. The amount of ready-made clothing is not estimated, but large establishments exist, particularly in the city of New York, and immense quantities are shipped to the southern states, and to foreign ports. Cabinet ware of every description is manufactured, not only for home consumption, but for shipment in large quantities to southern ports, South America, and the West Indies. Machinery, pianofortes, and carriages, are likewise manufactured on an extensive scale throughout the larger cities of the state. There are, besides, a multitude of smaller manufactures, such as those of gunpowder, fire-arms, chemical compounds, pigments, including white-lead and other paints, pencils, printing types, and tobacco; and others including the construction of ships and boats, chiefly for the navigation of the great lakes. The Onondaga salt-springs are situated in the town of Salina, Onondaga county, and are the property of the state. The salt is manufactured at four different villages, viz. Salina, Syracuse, Geddes, and Liverpool; and in the year 1833 the state of the manufacture was as follows: Number of manufactories, 131; number of kettles, 3309; number of gallons in the kettles, 312,795; and number of bushels manufactured, 1,838,646. Of this quantity about 103,000 bushels were made by solar evaporation. Coarse salt, of equal purity to any in the world, is also manufactured, and sold at a price which nets the manufac-

[1] By an omission in the act respecting the taking of the census of the state, the *male* aliens only were enumerated in 1835. The number of female aliens is estimated at 80,018, making a total of 162,337 aliens.

[2] This must refer only to permanent paupers, or such as are constantly in poor-houses.

New York. turer nine cents per statute bushel of fifty-six lbs.; and fine salt is sold at six cents. The trade in salt has been pushed to a considerable extent in competition with the foreign article, particularly since the reduction of the duty in 1834. During that year 1,943,252 bushels were manufactured; and in 1835 the quantity made amounted to 2,222,694 bushels.

Exports and imports. The following table presents a view of the exports and imports of New York, for several years, each ending the 30th of September.

Years.	Value of Imports.			Value of Exports.		
	In American Vessels.	In Foreign Vessels.	Total.	Domestic Produce.	Foreign Produce.	Total.
	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.
1821	21,926,635	1,702,611	23,629,246	7,896,605	5,264,313	13,162,547
1825	47,751,844	1,887,330	49,639,174	20,651,558	14,607,703	35,259,261
1830	33,432,098	2,191,972	35,624,070	13,618,278	6,079,705	19,697,983
1833	51,832,033	4,086,416	55,918,449	15,411,296	9,983,821	25,395,117
1835	82,783,459	5,407,846	88,191,305	21,707,867	8,637,397	30,345,264

The number and tonnage of vessels entering and departing from New York have of course increased in proportion to the trade. In 1830 there entered of American tonnage 298,434, and departed 229,341; and of foreign tonnage there entered 35,344, and departed 36,574; making a total of American and foreign which entered 333,778, and which departed 265,915 tons. In 1835 there entered of American tonnage 676,173, and of foreign tonnage 357,575, making a total of 1,033,748 tons. During the same year there departed, of American tonnage 589,855, of foreign 343,078, making a total of 932,933 tons. The value of the merchandise annually loaded and unloaded in the port of New York is estimated at from 100,000,000 to 120,000,000 dollars. The number of vessels in the port in the busy season varies from 500 to 750, exclusively of about fifty steam-packets. The total value of the imports into the United States in the year ending on the 30th of September 1832, was 101,029,266 dollars, of which no less than 53,214,402, or more than one half, were imported into New York. The value of the exports from the same place is estimated at between one third and one fourth of the total exports from the whole of the United States.

It will be seen from the above table, that the imports into this state greatly exceed the exports. This is accounted for by the fact, that whilst almost all articles of export from the western states are shipped at New Orleans, the greater part of the more valuable articles brought from foreign countries, and destined for the consumption of Ohio, Indiana, Illinois, and to some extent even of Kentucky, are principally imported into New York. The customs' revenue on the goods paying duties imported into the city of New York amounts to about thirteen millions of dollars, which is more than one half of the total customs' revenue of the entire United States. The imports comprehend an infinite variety of articles. The principal are cottons, woollens, linens, hardware, and cutlery; earthenware, brass and copper manufactures, and other articles, from Great Britain; silk, wine, brandy, and other articles, from France and Spain; sugar and coffee from the Havannah and Brazil, together with tea, spices, cochineal, indigo, dye-woods, and other articles. The nature of the principal articles of native American produce exported from New York will be seen by the following returns for the 1st of January 1833.

Ashes, pot	barrels	18,241
Ditto, pearl	ditto	2,356
Beef	ditto	17,223
Pork	ditto	29,418
Lard	kegs	11,101
Butter	kegs	9,286
Cotton	bales	108,741
Cotton goods	packages	7,545
Flour (wheat)	barrels	195,614
Corn	bushels	93,716
Rice	tierces	16,678
Tar	barrels	18,537
Turpentine	ditto	144,878
Hides	number	169,493
Whale oil	gallons	1,392,600
Soap	boxes	76,981
Tobacco	hogsheads	7,783

The tonnage of New York is greater than that of any other city in the world, with the single exception of London, and constitutes between one fifth and one sixth of that of all the United States put together. By a return of the 1st of January 1834, it amounted to 319,209 tons.

The following is a return of the amount of tonnage in the state in 1836. New York, 359,222, with 15,903 of steam navigation; Sag Harbour, 12,314; Buffalo Creek, 3740, with 1680 of steam navigation; Sackett's Harbour, 2236, with 280 of steam navigation; Oswego, 2040, with 406 of steam navigation; Oswegatchee, 799, with 417 of steam navigation; Champlain, 616; Genesee, 636; and Cape Vincent, 860. These facts will convey, it is hoped, a sufficient idea of the vast extent of the commerce of New York.

Finances. This state borrowed a considerable sum for the construction of its canals, particularly the Erie and Champlain Canal, which debt is in the course of being redeemed by the annual income of the state, which always greatly exceeds the expenditure. There are several funds belonging to the state, viz. the general, common school, literature, canal, and bank funds: but the general fund consists of bonds and mortgages for lands sold, loans, and other debts due to the state. For the year ending the 30th of September 1833, the finances stood as under:[1]

		Dollars.
Permanent revenue for interest on bonds, bank stock, and other items	62,232·26 dol.	
Capital,—bonds for lands, &c.	125,917·70	
Miscellaneous,—loan from the bank fund	83,149·83	
Sundries	40,962·89	
		312,262·68
Canal fund,—the receipts arising from tolls, auction duty, salt duty, interest on deposits, and other items		1,804,433·64
Carry over		2,116,696·32

[1] From Williams's New York Annual Register for 1834.

	Dollars.
Brought over............	2,116,696·32
Common school fund,—capital in bonds for lands, bank-stock, &c..........140,985·14 dol.	
Revenue from interest on stock..109,117·77	
	250,102·91
Literature fund,—capital in bonds for lands, and various kinds of stock......12,155·00	
Revenue from interest on stock, &c................................22,577·22	
	34,732·22
Bank fund,—capital..................95,381·48	
Revenue.......................... 3,954·79	
	99,336·27
Total receipts.........	2,500,857·72
The payments made during the same period were permanent appropriations, such as expenses of government for salaries, and other necessary outlays...332,041·67	
Special appropriations, and temporary expenses................ 73,949·98	
On account of canal fund.......1,798,213·05	
Common school fund........... 113,238·36	
Literature fund, dividends to academies, &c.................. 10,470·96	
Bank fund, salaries of bank commissioners..............4,500·00	
Loan to the general....83,149·83	
87,649·83	
Total amount of warrants on the treasury...	2,415,563·85
Balance........	85,293·87

From the large annual receipts obtained from tolls, auctions, sales of lands, and other items, the property of the canals, it is expected that the canal debt will be paid off long before the time fixed on for redeeming the whole of the stock.

Banks and insurances, army and navy.

In 1829 an act was passed requiring every bank thereafter to be created or renewed, to contribute annually one half of one per cent. on its capital to a fund intended for the payment of the debts of such banks as may at any time become insolvent. These banks are placed under the supervision of commissioners, to whom they are required to make annual reports of their condition, and are called "safety-fund banks." In 1830 there were thirty-seven banks in New York state, having a capital of 20,083,353 dollars. In 1836 there were eighty-seven banks, and two branch banks, which stood thus: Specie funds, 670,363 dollars; specie, 7,221,335; capital, 31,881,460; circulation, 16,427,963; and deposits, 22,000,000 of dollars. The whole of these banks, with the exception of seven or eight, are safety-fund banks. There are, besides, nine savings banks, having a total capital of 3,855,517 dollars. In the city of New York there are thirteen marine insurance companies, with a capital of 4,550,000 dollars; and twenty-eight fire insurance companies, with a capital of 10,250,000 dollars. In the other parts of the state there are about twenty-two insurance companies, with a total capital of above four millions of dollars. In 1835 there were 1687 post-offices in the state of New York, and the amount of postages for the preceding year was 430,426 dollars, of which 192,493 dollars were for the city of New York alone. In 1834, the military establishment (militia) of New York stood thus, viz. horse artillery 1687, cavalry, 7080, artillery 11,669; infantry, including riflemen, 164,979; companies of artillery attached permanently, or for inspection, 3032; total number of men, 178,447. There are five vessels of war employed in ordinary at New York.

Religion.

The constitution of this state secures toleration of religious worship, so that every denomination is to be found in it. The following is a statement of the number of the clergy of different denominations in 1835: Presbyterians and Congregationalists, 562; Methodists, 492; Baptists, 442; Episcopalians (one bishop), 181; Dutch Reformed, 116; Lutherans, thirty; Associate Reformed, twenty-three; Roman Catholics, one bishop and thirty-five ministers; Universalists, upwards of twenty; Unitarians, eight; New Jerusalemites, five; Shakers, two societies; Jews, three synagogues; the Friends, a considerable number of societies; besides various other denominations not enumerated in this list, as well as a number of licentiates and candidates belonging to those given, particularly to the Presbyterians. The clergy are supported by subscription, contribution, rents of pews, income from funds, and other sources. The salaries in the city of New York vary from 1000 to upwards of 3000 dollars. The average annual salaries of the clergy of this state are estimated as not exceeding 500 dollars each. The state of the theological seminaries in 1836 was as follows:—General theological seminary of the Protestant Episcopal church in the United States, located in New York, instituted in 1819, four professors, eighty students, and 3880 volumes in the library; the Presbyterian theological seminary at Auburn, Cayuga county, instituted in 1821, four professors, fifty-one students, and 4500 volumes in the library; the Hamilton literary and theological seminary (Baptist), at Hamilton, Madison county, instituted in 1829, eight instructors, 124 alumni, eighty-three students, and 1600 volumes in the library; the Hartwich theological seminary (Lutheran), at Hartwich, Otsego county, instituted in 1816, two professors, nine theological and a number of academical students, and 1000 volumes in the library; and the Oneida institute of science and industry (Presbyterian), near Utica, about fifty students and 1000 volumes in the library. The Baptist college at Brockport, Monroe county, the Methodist academy, White Plains, Westchester county, and a conference seminary belonging to the same sect at Cazenovia, Oneida county, and the Genesee Wesleyan seminary, Lima, Livingston county, also belong to the list of religious institutions. Amongst these may be included the American Bible Society, which has its seat in the city of New York, where a spacious building has been erected for it; the United Missionary Society, instituted at New York in 1817; the American Home Missionary Society, instituted at the same place in 1826; together with several missionary, tract, Sunday school, and other religious societies, which have various ramifications throughout the state. The benevolent institutions are upon a very extensive scale. There are asylums adapted to almost every case of human deprivation and misery; for the deaf and dumb, the blind, the orphan, the widow, the indigent, the aged, and the stranger. In 1834 their number, including religious benevolent societies, was forty-eight, and since then they must, like every thing else, have increased. It may be mentioned, that temperance societies flourish better in New York, and some of the other states, than they seem to do in any other part of the world.

Education.

Since the establishment of the state government, great exertions have been made by the legislature to extend the means of education to all classes of the community. The appropriations made for this purpose, including the capital and income of the common school and literature funds, amount to above six millions of dollars. The common schools are amongst the most important and interesting institutions in the state. Every town is divided into a suitable number of school districts, in each of which a school-house has been erected, and is provided with furniture and fuel at the expense of the district. The following notices are derived from the Annual Report of the superintendent of common schools, made in January 1835.

New York.

	Dollars.
Interest at six per cent. on 2,116,000 dollars invested in 9580 school-houses	186,960·00
Annual expense of books for 531,240 scholars at fifty cents each	265,620·00
Fuel for 9580 school-houses, at ten dollars each	95,800·00
Public money derived from the school fund	100,000·00
Ditto derived from local funds belonging to some towns	18,538·56
Ditto levied by taxation on the property of the people	197,615·37
Amount paid for teachers' wages, besides public money	398,137·04
Making the total expense of these schools in 1834	1,262,670·97

The number of children actually receiving education is one in every 3·95 of the whole population. Complaints are made by the superintendent of these schools, of the incompetency of teachers, from the smallness of the remuneration which they receive. The rate of wages, however, is regularly advancing, and competition will gradually cure the evil which exists in this well-organized system of education. By a report of the regents of the university, made in 1833, there were in the state of New York sixty-five incorporated academies, which had 4856 students. The whole state is divided into eight districts, to each of which are apportioned 1250 dollars out of the income of the literature fund, making a total of 10,000 dollars given annually for the support of these institutions. There are also in New York above twenty Protestant and four Roman Catholic free schools, several infant schools, and a number of female and other seminaries of education supported by private individuals, the enumeration of which would form but a dry catalogue of names.

There are six colleges in this state, including the University of New York. The following is the return for 1836: University of New York, established in the city of that name, founded in 1831, seventeen instructors, and 226 students; Columbia College, New York (Episcopalian), founded in 1754, eleven instructors, 1620 alumni, 100 students, 8000 volumes in the college library, and 6000 volumes in the students' library; Union College, Schenectady, founded in 1795, ten instructors, 1600 alumni, 308 ministers, 268 students, 5350 volumes in the college library, and 8920 in the students' library; Hamilton College, at Clinton, founded in 1812, seven instructors, 270 alumni, sixty-nine ministers, 101 students, 2500 volumes in the college library, and 3700 volumes in the students' library; Geneva College, at Geneva (Episcopalian), founded in 1823, seven instructors, eighteen alumni, nine ministers, twenty-two students, 820 volumes in college library, and 1150 in the students' library. There is, lastly, the Hamilton Literary and Theological College, which we have already noticed in connection with religious institutions. There are four medical schools, viz. the College of Physicians and Surgeons, at New York, having seven professors, and 158 students; the College of Pharmacy, of the city of New York; the College of Physicians and Surgeons, at Fairfield, with five professors, and 190 students; and the Geneva Medical College, at Geneva, having six professors, and sixty-eight students. The other medical institutions are, the Medical Society of the State of New York; the New York State Vaccine Institution; the Kappa Alpha Phi Society; the New York Eye Infirmary; the Albany County Medical Society; the Medical Society of the City and County of New York; besides a Lunatic Asylum, the New York Hospital, and two or three other hospitals and asylums. There appear to be no law schools, but there are the New York Law Student's Association, instituted in 1833 for purposes of mutual discussion on subjects connected with the legal profession; also the New York Law Institute, established in 1828, for much the same purpose as the preceding, and likewise in order to form a large library of law-books. In 1834 there were 2650 physicians and surgeons, and 2052 attorneys and counsellors in this state.

Literature, science, and the press.

There are numerous literary and scientific institutions in New York. The principal public libraries, besides those already mentioned, are, in the city of New York, the New York Society Library, 25,000 volumes; New York Mercantile Library, 11,400 volumes; New York Apprentices' Library, 10,800 volumes; New York Historical Society Library, 10,000 volumes; New York Law Institute Library, 2100 volumes; and the Albany Library, 8000 volumes. The principal institutions are, the New York Historical Society, established in 1809, which, besides its library, has a valuable collection of coins and medals; the New York Athenæum, established in 1824, for the promotion of science and literature; the Lyceum of Natural History, established in 1818, and which possesses a valuable library and museum of natural history; the New York Literary and Philosophical Society; the American Academy of Fine Arts, established in 1808; the American Lyceum, formed in 1831, for the diffusion of useful knowledge; the National Academy of Design, established in 1826; the Clinton Hall Association, established in 1830, for the cultivation and promotion of literature, science, and the arts; and the New York Sacred Music Society, established in 1823. In the city of Albany, besides the library mentioned, there are, the Albany Institute, established in 1829, the museum of which, besides a considerable library, contains above ten thousand specimens in geology, mineralogy, and botany, with coins, engravings, casts, and other articles of vertû; the Athenæum, established in 1827, in connection with the Albany Library; and the Northern Institute and Academy of Fine Arts, established in 1831. In the county of Rochester, there are the Rochester Athenæum, established in 1830, for promoting literature, science, and the arts; the Franklin Institute of Rochester, established in 1830, for the same purposes as the preceding; and the New York State Lyceum, formed at Utica in 1831. The other principal institutions are, the New York Chamber of Commerce; the General Society of Mechanics and Tradesmen of the city of New York; the American Institute of the city of New York, for promoting the interests of agriculture, commerce, manufactures, and the arts; the New York Board of Trade; three Horticultural Societies; the Linnæan Botanic Garden, and other gardens; the New York State Society of the Cincinnati; the Merchants' Exchange Company, two typographical, and some other associations. There is a law journal published once a month at New York. In the same city there are issued, of literary and miscellaneous journals, two quarterly reviews, one every two months, six monthly, one every fortnight, and two weekly periodicals in English, and two in French, together with a republication of the Edinburgh Review and some of the leading journals of Europe. At Albany there is one magazine, and at Schenectady another. Of religious journals there are thirteen published in the state, mostly at New York, and in general monthly. There are also three or four agricultural, horticultural, and temperance publications; the total number of journals published in 1834 being forty. In 1810 there were only sixty-six newspapers published in New York; in 1834 they had increased to 267, of which number twenty-one were daily papers.

Prisons and pauperism.

In each county of this state a jail is established by law. Previously to 1824 jails were very badly managed, but an examination which took place during that year led to the formation of the Prison Discipline Society, "an institution," says the American Almanac for 1836, "which has already

New York. been productive of the most important and beneficial effects with respect both to the condition and character of the prisoners, and the well-being of society." All the penitentiaries, with the exception of that at Auburn, were so constructed and managed as to render them only schools of vice and crime; but the object of this society is so to improve prisons in construction and discipline as to produce, as far as possible, the reformation of prisoners. The system adopted is that known by the name of the Auburn plan, and its principal features are, solitary confinement at night and during meals, and combined labour at other hours of the day; religious instruction, particularly on Sunday; and absolute silence amongst the prisoners at all times. The cells are so constructed as to answer the various ends which the society had in view. During the hours of labour the prisoners are employed in workshops, or in the prison yard, in parties of a convenient number each. Attention is paid to health, by the complete ventilation of the small cells, where the prisoners sleep and take their meals; and, to secure the well-working of the system, every violation of the rules laid down is punished by solitude, darkness, or such other infliction as may be found necessary to enforce obedience. The eighth report of the society speaks with confidence of the "favourable moral results;" and observes, on the whole, in regard to the state prisons, that there is great cause for congratulation and thankfulness. By the same report there are stated to be in prison at Auburn 876 individuals; and the balance of profits in favour of the prison, arising from the earnings of the prisoners, is stated at between eight and nine thousand dollars. The Mount Pleasant state prison, Westchester county, is likewise an admirable establishment, and in excellent condition; as is also that at Sing Sing. The mode of supporting the poor, which, in America, has been found most economical, and best calculated to discourage pauperism, is that of maintaining them in county poor-houses. The former law of settlement, and the practice of compulsory removals, have been abrogated, and a simple rule of settlement, founded principally on the residence of the party, and a summary mode of settling disputed questions, substituted in their stead. The following is an abstract taken from Williams's New York Register for 1834: "Reports have been received from all the organized counties in the state, fifty-five in number. All these counties have erected poor-houses, with the exception of six; and thirty-seven counties have abolished the distinction of town and county poor. The practical operation of our present poor-house system demonstrates satisfactorily, that it has a decided advantage on the score of economy over every other existing mode of supporting indigent persons; and that the expense of the system, in proportion to the number of paupers supported, is regularly diminishing." The annual expense of supporting each pauper is stated at thirty-two dollars twenty-one cents. The total number of paupers in the state relieved or supported during 1832–33 was 35,777, of whom only 2252 were town paupers. The aggregate expense of relieving and supporting the whole number was 295,239·15 dollars. There are attached to the poor-houses in the state 5776 acres of land; and the aggregate value of all the establishments amounts to 865,770 dollars, of which the New York city establishment has 248 acres of land, valued at 550,000 dollars. The number of paupers permanently in the poor-houses of the state will be found in the census of the population.

Miscellaneous. It is scarcely necessary to state, that mails and stages pass between New York and the large towns of the state, and also of the Union generally. Their number is commensurate with the demands of a large mercantile city, and the wants of civilized life. The lines of packets from the port of New York for foreign parts are numerous, including those to Liverpool, London, Belfast, Havre, Jamaica, Carthagena, and Mexico. The principal lines of packets between New York and other ports of the United States comprise those to Charleston, Savannah, New Orleans, Mobile, Apalachicola, Darien, Baltimore, Washington, Philadelphia, Boston, New Haven, Salem, and the principal ports to the east. There are lines of packet-boats on the Erie Canal, and steam-boats without number plying on all the waters of this state. On the river Hudson, where steam-navigation was first tried, it is common for one steam-boat to tow ten other boats laden with goods.

By the amended constitution of this state, adopted in the year 1821, the legislative power is vested in a senate consisting of thirty-two members, and a house of representatives consisting of 128 members, all of whom receive three dollars per diem for their services. The senators, who must be freeholders, are elected for four years; but the members of assembly are elected annually. To facilitate elections, the state is divided into eight districts, each of which is entitled to four senators, one of the number being annually appointed in each district. The members of the other house are chosen by the several counties amongst whom they are apportioned, according to a rule prescribed in the constitution. The executive power is vested in a governor, who holds his office for two years. A lieutenant-governor is elected at the same time, and holds his office for the same term of years. He is president of the senate, and officiates as governor when that office becomes vacant. The franchise is exercised by every male citizen twenty-one years of age, who has been for one year resident in the state, and for six months an inhabitant of the county in which he votes. The suffrage is thus very extensive, and the number of electors is accordingly very great. In 1832 the total number of votes for governor, exclusive of scattering votes, was 323,082. Sheriffs, coroners, and county clerks are elected by the people; but the other civil officers are generally appointed either by the governor and senate, the two branches of the legislature, or the governor alone, excepting clerks of courts, district attorneys, and some other officers, who are appointed by the courts.

The judicial establishment consists of several courts. That for the trial of impeachments and the correction of errors is composed of the president of the senate, the thirty-two senators, the chancellor, and the justices of the supreme court. It is the court of last resort, deciding upon appeals from the court of chancery, and writs of error from the supreme court, but has no original jurisdiction, excepting in cases of impeachments. Its sessions are held at the Capitol in Albany, or at the City Hall in New York. The next is the court of chancery, the powers of which are vested in the chancellor, and in eight vice-chancellors. The third is the supreme court, consisting of the chief justice and two associate judges. Lastly, there are eight circuit courts, each consisting of a single judge. The circuits correspond, both in territory and in name, with the eight senate districts. Each of the circuit judges possesses the powers of a justice of the supreme court at chambers, in the trial of issues joined in the supreme court, and in courts of oyer and terminer, and jail delivery. There must be held in each year at least two circuit courts, and courts of oyer and terminer, in each county in the state; and in the city of New York at least four. The courts are held during as many days as the judge thinks necessary. Courts of oyer and terminer, having power to try all crimes and misdemeanours, may be held at the time and place at which any circuit court may have been appointed. The governor, with the senate, has the power of issuing commissions of oyer and terminer and jail delivery, when occasion shall require.

Besides the powers exercised in the courts of law by the circuit judges, each circuit judge (except the judge of

New York. the first circuit) within the limits of his circuit must be a vice-chancellor, and, concurrently with the chancellor, but exclusively of any other circuit judge, must have and exercise all the original jurisdiction and powers now or hereafter vested in the chancellor, in all causes and matters in equity, where the same shall have arisen within his circuit, or where the subject-matter in controversy is situated within such circuit, or where the defendants, or either of them, reside within the same, but subject to the chancellor's appellate jurisdiction. By an act of the legislature, passed in January 1831, the equity powers of the judge of the first circuit were taken away, and a separate vice-chancellor appointed for the first circuit. The superior court of the city of New York consists of a chief justice and two associates. There are courts of common pleas in each and every county of the state, which may be held (except in the county of New York) by the judges of the county courts of each of the counties in this state, or any three of them. Any three of the judges of the county courts of each of the counties (except New York) have the power to hold courts of general sessions to try all crimes excepting those punishable with death or imprisonment for life. The mayor, recorder, and aldermen, or mayor and recorder jointly, or either of them singly, may, with or without the presence of any of the aldermen, hold mayor's courts in the cities of Albany, Troy, and Hudson.

Besides the above, there are certain courts of a peculiar and special jurisdiction. Surrogates' courts have jurisdiction of testamentary cases, held by the surrogate of each county. Courts of special sessions of the peace may be held in and for the county of New York, by any three judges of the court of common pleas of the said county, of whom the first judge of the said court, the mayor, or recorder, shall always be one; and for the several counties of the state, by three justices of the peace, or by two such justices and one judge of the county courts of such county, for the purposes provided by law. The justices of the marine court in the city of New York are authorized to hold a court therein, called the Marine Court of the city of New York. Each of the assistant justices in the city of New York is required to hold a court in the said city within the ward or wards for which he is appointed. The justices of the justices' court of the cities of Albany and Hudson are authorized to hold courts therein, called respectively the Justices' Court of the city of Albany, and the Justices' Court of the city of Hudson. Justices' courts in each county are held by a justice of the peace.

The constitution of this state has been admirably framed, and not only embodies many of those safeguards usually inserted in bills of rights, but has some provisions of a peculiar character, by which public property and public institutions are secured and protected, scruples of conscience in regard to bearing arms are obviated, and ministers of the gospel or priests are excluded from all civil and military offices. The common law of England, varied from time to time by numerous acts of the colonial and state legislature, forms the basis of the jurisprudence of New York. Since American independence was established, there have been four revisions of the statute laws of state. The last, which took place in 1827–28, was the most important; and the enactment of this body of statute law, which came into full operation on the 1st of January 1830, is perhaps one of the most important events in the history of American jurisprudence.

City of New York. The capital of this state is Albany, but by far the largest and most populous city is New York, the commercial emporium of the United States. It is situated on New York Island, formerly called Manhattan Island, at the confluence of the Hudson or North River with the strait called the East River, which connects Long Island Sound with the Atlantic Ocean. It is less than twenty miles from the western extremity of Long Island Sound on the north-east, and the Atlantic Ocean on the south. The City Hall is in latitude 40. 42. 40. north, and longitude 74. 2. 8. west from Greenwich. The city and county are of the same limits, comprising the whole island, which extends from the battery on the south to Kingsbridge on the north, thirteen miles and a half. The average breadth is a mile, but in one part it is two miles and one third across; and the area of the island is about 14,000 acres. It is separated from the continent on the north by Haerlem River, which is crossed by several bridges; from New Jersey on the west by Hudson's River; from Long Island on the east by East River; and from Staten Island to the south by the bay or harbour. The island of New York is formed on a bed of rocks, generally primitive granite, with some limestone in the northern section, where there are quarries of white marble. The elevation above tide-water is very considerable throughout the whole extent, in some parts 238 feet. The general slope of the island is from west to east, and an elevated range of ground runs in this direction, which slopes towards the northern and southern parts of the island. This physical feature of the island is considered as of great importance, since it enables water reservoirs to be so located as to command the whole city at an elevated head. The harbour or bay, which is twenty-five miles in circumference, is safe and commodious, and the largest vessels may come up to the very wharfs of the city. On the bar the depth of water at high tide is twenty-seven feet, and at low water twenty-one feet; and thence to the city the channel is from thirty-five to fifty feet deep. There is a lighthouse at Sandy Hook, on the New Jersey shore, eighteen miles distant from the city; and vessels frequently anchor in the outer harbour, or Raritan Bay. The entrance to the harbour is called the Narrows, between Staten Island on the west and Long Island on the east, about eight miles from the city. There is a lighthouse on the western part of the latter island, twenty miles north-east of New York. The harbour is rarely obstructed with ice. The principal commercial business is transacted on the east side of the city, the East River being the most safe and convenient part of the harbour. The width of the East River is from one third to one half of a mile to the opposite shore of Brooklyn, on Long Island. The Hudson, or North River, is one mile in width opposite to Jersey city, and a mile and a half at Hoboken, New Jersey. The approach to New York by sea is one of the most splendid sights of the kind which the world can present. The works of nature are here on the grandest scale, and the *tout ensemble* of islands, rivers, bays, and forests of masts, with spires towering amongst the trees which shade the streets, constitute a scene as varied and interesting as can be beheld.

The principal fortifications for the defence of the harbour are at the Narrows, about eight miles from the city. But on the Long Island shore are Forts Hamilton and La Fayette; and opposite them, on Staten Island, are Forts Tomkins and Richmond. There are several small islands in the harbour; and upon those called Bedlow's and Ellis's Islands, situated on the western side, there are batteries; whilst Governor's Island, opposite to the battery, and very near the city, is strongly fortified. The Battery is situated at the south-west extremity of the city, and is handsomely laid out, being intersected with gravel walks, and tastefully decorated with shrubs and trees. Castle Garden, connected with the Battery by a bridge, is a fine promenade, and is much frequented during the summer. A telegraph is established on the heights of Staten Island, communicating by signals with one in the city. A panorama of New York presents the compact part of the city occupying the southern part of the island, and stretching along each river about three miles. It is, generally speaking, regularly built, the

New York. principal streets running north and south, and being crossed by others extending from the river on the east to that on the west. Great improvements have been made on the compact part of the city within the last ten or twelve years, the clumsy fabrics of the Dutch having given place to the more tasteful and convenient erections of modern times. The style of building with granite and marble fronts to the basements is now almost uniformly adopted in the construction of warehouses. The northern part of the city has been very handsomely laid out in wide streets and spacious avenues; and the style of building for dwelling-houses is neat, and frequently elegant.

Broadway, the most splendid street in the city, or in the United States, runs through the centre, and extends three miles in length from north to south, terminating at the Battery. It is eighty feet wide, and generally presents massive and noble buildings, including three fine churches, several large hotels, Washington Hall, the Masonic Hall, with a variety of elegant shops. From this street there is a gentle slope east and west to the rivers. The following is a summary of the principal streets in this city, from a work entitled New York as it is in 1833.[1] "Greenwich Street is wide and elegant, and runs parallel with Broadway, between that street and Washington Street, which last is a fine avenue, next to West Street, extending along the North River. Pearl Street, between Broadway and the East River, is above a mile in length, and its course is nearly in the form of a crescent, containing numerous spacious warehouses, and is the principal seat of the dry goods and hardware business. Front and Water Streets, between Pearl Street and the East River, are occupied principally by the wholesale grocers, commission merchants, and mechanics connected with the shipping business. South Street, running along the East River, contains the warehouses and offices of most of the principal shipping merchants. Wall Street runs from Broadway to the East River, and is occupied by the banks, insurance companies, merchants' exchange,[2] newspapers, and brokers' offices, being the seat of heavier monied transactions than any other place in America. Canal Street, running across Broadway to the Hudson River, near the centre of the city, is a spacious street, principally occupied by retail stores. The Bowery is a wide and extensive street, running directly north and south-east of Broadway. The third avenue, extending from the Bowery to Haerlem, is macadamised, and is the principal avenue to the city from the east. Chatham Street, East Broadway, Nassau Street, Maiden Lane, Broad, Fulton, Cortland, William, Hudson, Division, Grand, and Broome Streets, deserve particular notice, as among the principal streets and avenues. The streets are generally well paved, with stone or brick side walks, and lighted at night."

In enumerating the public buildings, the first place belongs to the City Hall, which is the most prominent and important edifice in New York. It is situated in the Park, about half a mile from the Battery, and is 216 feet in length by 105 in breadth, and, including the attic story, sixty feet in height. The front and ends are built of white marble, behind it is of free-stone, and it consists of a centre building and two wings, principally of the Ionic and Corinthian orders. The *tout ensemble* is elegant, if not splendid, and New York. the edifice reflects great credit on the inhabitants for their munificence and taste. It was commenced in 1803, and finished in 1812, at a cost of 538,734 dollars. It consists of the City Hall proper, comprising a large suite of rooms for holding the different courts of law, and which are fitted up in a rich and expensive style; and of the new City Hall, which includes the police office, and a number of offices and rooms adapted to various necessary purposes. Many of the churches are in general large, but there is nothing in their architecture, or that of the steeples, particularly requiring notice. There are above one hundred places of worship in New York, which is about the same proportion to the number of inhabitants that we find in Great Britain. Columbia College, above the City Hall, is advantageously and handsomely situated in a fine square. The edifice and grounds attached are extensive, and it possesses an estate valued at 400,000 dollars. The college contains a chapel, lecture rooms, hall, library, museum, and an extensive philosophical and astronomical apparatus. The standard of classical education is supposed to be higher here than in most of the other colleges of the Union. The University of the city of New York is projected on the broad and liberal scale of the universities on the continent of Europe, and promises to be of great advantage to the literature of the country. It is governed by a council of thirty-two members, chosen by the subscribers, together with the mayor and four members of the common council of the city. The New York Institution is a brick building, 260 feet in length by forty-four in breadth, and is appropriated to associations of literature and the fine arts, such as the Literary and Philosophical Society, the American Academy of Fine Arts, and the like. The State-prison and the Lunatic Asylum are large edifices, built of stone. The Alms-house and the Asylum for the Deaf and Dumb are also buildings of ample dimensions, built of brick. The Park Theatre is a spacious edifice, eighty feet long, 165 feet deep, and fifty-five feet high, and is calculated to contain 2400 persons. The New York Theatre, in the Bowery, displays much architectural beauty, and amongst the modern ornaments of the city stands pre-eminent. It has a front of seventy-five feet, and is 175 feet deep and fifty feet high. Besides these, there are other theatres and places of public amusement in New York. The Medical College is a conspicuous edifice; and the following are spacious buildings: Clinton Hall, the Bible Society's Depository, the American Tract Society's buildings, the Arcade and the Arcade Baths, the New York Baths, the Public Marine Bath, the Manhattan Water-works, the Exhibition Room of the National Academy of the Arts of Design, Rutger's Medical College and Public School, Masonic Hall, Orphan Asylum, Fever Hospital, House of Refuge for Juvenile Delinquents, the City Hotel, the Mansion House, the National Hotel, the Franklin House, Tammany Hotel, and several other hotels. The markets, banks, insurance offices, school-houses, and buildings for public institutions of all kinds, are quite as numerous as in British cities, the difference of population being taken into account. A number of squares have been laid out in the upper part of the city, the principal of which is Washington Square: Hudson's Square or St John's

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[1] By Edwin Williams, author of the New York Annual Register.

[2] This, along with a considerable portion of the city of New York, was consumed by fire on the 16th and 17th days of December 1835. The following account of this destructive conflagration is from the American Almanac for 1837:—"Sixteenth. A tremendous fire breaks out in the city of New York, at nine o'clock in the evening, and is not fully suppressed till one o'clock P. M. on the 17th. It commenced near Wall Street, and destroyed most of the entire seat of the greatest mercantile transactions of the city, although comparatively but little inhabited. It was the most destructive fire that has ever taken place in the United States. The loss, according to the official report of the committee, amounted to 17,115,692 dollars. The merchandise destroyed was estimated at 13,115,692 dollars; the buildings, the number of which was 529, at 4,000,000 dollars. The Merchants' Exchange, a magnificent edifice of marble, was estimated at 150,000 dollars, and the Garden Street Church at 50,000 dollars." The places of the destroyed edifices have been supplied with buildings of the same description, with a rapidity quite unparalleled in any other country. In March 1836, Congress passed a bill for the relief of the sufferers; but no aid was solicited from abroad.

New York. Park is part of the extensive tract of land, in the north-western part of the city, belonging to Trinity Church. It comprises an area of four acres, and the square is enclosed with costly and valuable private dwellings, having St John's Church on its western side. Amongst the places of fashionable resort in the city and its vicinity may be mentioned the Battery, which extends somewhat in the form of a crescent along the southern extremity of the city, and covers an area of nearly eleven acres. This favourite promenade was originally a fortification thrown up by the Dutch, and planted with cannon, from which circumstance it derives its name. But it is now divested of its warlike appurtenances, having for many years been used as a public walk; and being shaded with trees, and constantly fanned by the ocean breezes, there is not a more agreeable or healthful retreat during the summer months. In or near the city there are a number of parks and public gardens, which are also much frequented. With regard to the buildings of New York in general, Mr Stewart observes,[1] "The churches, at least many of them, are large, but there is nothing in their architecture, or that of the steeples, particularly requiring notice. There is no building here to bear any thing like a comparison with many of the public buildings in the European capitals, such as St Martin's Church in London, the front of the Register Office in Edinburgh, or that of the Chamber of Deputies at Paris; but there are churches and public buildings in all those cities quite as deficient in good taste as any of those which I observed here. In short, my notion is, that, though there is no very fine building in the city, there is not much to hurt the eye of the fastidious; and the city is generally composed of clean-looking buildings and streets, and is regularly built." New York is divided into fifteen wards, each ward electing annually an alderman and an assistant alderman, two assessors, one collector, and two constables, who are formed into a common council of two boards. The mayor is elected annually by the joint ballot of both boards. The situation of the city is considered as very favourable to the health of the inhabitants, from the elevation of the island, and the vicinity of the ocean. The climate at most seasons is mild and agreeable, the winters being less severe than in the interior of the state, and the sea-breezes rendering the heat of summer less oppressive.

The religious, benevolent, and other institutions, the banks, insurance offices, and miscellaneous companies, the state of the press, literature, religion, and education, the manufactures, trade, commerce, lines of packets, and stages, of New York, have been already enumerated in the general account of the state, as fully as our limits will permit. There is no city in the United States, perhaps in the world, which possesses greater advantages of situation than New York, both for internal and external commerce; and these have been immensely increased by art. It is hither that merchants and traders resort from all quarters, from the shores of the Atlantic, the confines of the lakes, and the banks of the great Mississippi, with a certainty that they can dispose of their own produce, and supply themselves with every article which they require. It is at this point that the vast stream of immigration at first collects, as in a reservoir, whence in course of time it distributes its contents over the whole country. Here, too, strangers and travellers congregate as the place of departure to every part of the world, attracted by the ample facilities afforded them at fixed and short intervals. It may serve to give some idea of these to state, that there are opportunities, by regular packets, to sail to Liverpool four times a month, to Havre three times, and to London twice a month. The advantageous situation of this city naturally inclines the inhabitants to commercial pursuits; but of late years large capitals have been invested in manufactures, which are becoming more and more objects of attention. But the probability is, that New York will long remain, in a great degree, a central point for the commerce of the United States. The numerous failures which occurred in America during 1837 have of course affected New York; but this is not the place to speculate on the causes and consequences of these casualties. One thing seems perfectly clear, that the natural resources and advantages of the United States are too vast ever to be permanently affected by the state of trade in any other country, at least for ages to come. The population of New York, and the principal cities in the state, for three periods, are as under.

	1820.	1830.	1835.
New York	123,706	202,589	270,089
Albany	12,630	24,209	28,109
Brooklyn	7,175	15,394	24,529
Troy	5,261	11,550	16,959
Buffalo	2,095	6,321	15,661
Rochester	1,502	9,269	14,404
Utica	2,762	8,323	10,183
Schenectady	3,939	4,268	6,272
Hudson	5,310	5,392	5,531
Poughkeepsie	3,401	5,023	6,281

Albany, the political metropolis, is situated on the western bank of the Hudson, 150 miles from New York, and has a position equally convenient for communication with that city and with a vast interior country. The appearance of Albany from the opposite side of the river is striking and splendid; its situation on the side of a hill is favourable for every part of it being seen, and the Capitol and public edifices are conspicuous objects. It consists of one street of very considerable length, running parallel with the river, from which the rest of the city rises abruptly. The Capitol, built upon the upper portion of Albany, on an elevated site, is 115 feet in length by ninety-eight in breadth. There are ten or twelve other public buildings, some of which are very handsome. This city is very rapidly increasing, as the population returns sufficiently indicate. The other towns enumerated in the foregoing list are also places of considerable and growing trade.

History. The history of New York is so closely interwoven with that of the United States generally, and the latter part of it in particular with the war of independence, and the subsequent consolidation of the country as a federal republic, that it is only necessary in this place to give a brief abstract of its early annals. That part of America to which New York belongs was discovered by Sebastian Cabot in the year 1497. He claimed the country for his sovereign, but made no effort to form settlements; nor was an undertaking of this kind attempted by the English until after the Dutch had colonized a portion of the country. It is certain that, in 1609, Henry Hudson, an Englishman, entered the bay of New York, and sailed up the river now called by his name, as far as latitude 43° north; but whether he was employed by the English government in this service, and sold the country which he thus discovered without authority, is a point not so clearly settled. English writers take this view of the case; but the Dutch historians assert that he was at the time in the service of the Dutch East India Company. At all events, the English for some time made no opposition to the settlement of the country by the Dutch, who immediately commenced

[1] Three Years in North America, by James Stuart, Esq. 1833.

a trade with the natives of the country. The right of the English to the territory, however, was formally recognised, by the Dutch applying for and receiving from James I. in 1620, permission "to build some cottages on Hudson's River, for the convenience of their vessels engaged in trade with Brazil." To the colony which they settled under this license they gave the name of the New Netherlands. Buildings were erected in the following year near the junction of the East and North Rivers, and a governor was appointed by the Dutch in 1629. Complaints were made by Charles I. of the encroachments of the Dutch on New England, and the states-general declared, that the settlement of New Netherlands was "only a private undertaking of the West India Company of Amsterdam." In 1664, Charles II. granted to his brother, James duke of York, "all Mattawacks, now Long Island, all Hudson's River, and all the lands from the west side of Connecticut River to the east side of Delaware Bay, together with the royalties and rights of government." James sold that part of the grant which comprehends New Jersey, and retained the remainder, which comprehends the present state of New York, a name bestowed upon it in honour of the proprietor. The states-general guaranteed the possession to him by the treaty of Breda in 1667. Previously to these transactions, however, the parties themselves had been settling the point of possession in the disputed territory itself. In 1664 the New Netherlands was taken by the English; in 1673 it was retaken by the Dutch; and in 1674 it again fell under the power of the English, to which it remained attached until the time of the revolution. The remaining portion of the history of New York belongs to that of the UNITED STATES. (R. R. R.)

NEXI, amongst the Romans, were free-born persons who had been reduced to a state of slavery for debt. By the laws of the twelve tables it was ordained, that insolvent debtors should be given up to their creditors, to be bound in fetters and cords; and though they did not entirely lose the rights of freemen, yet they were often treated more harshly than the slaves themselves. If any one was indebted to several persons, and could not within sixty days find a surety, his body according to some, but according to others his effects, might be cut in pieces, and divided amongst his creditors. The latter opinion seems the more probable, as Livy mentions a law by which creditors had a right to attach the goods but not the persons of their debtors.

NEY, MICHEL, a marshal of the French empire, and one of the distinguished generals produced by the French Revolution, was born at Sarrelouis, on the 17th of January 1769. His father had been a soldier, but, after the Seven Years' War, had retired to his native village, where he exercised the humble trade of a cooper. Young Ney received his education at a school kept by the monks of St Augustin, under whom he appears to have made considerable progress in his studies; but being fired with military ardour by the recitals of his father, he early enlisted into a regiment of hussars (*régiment du colonel-général*), where he served for some time, and was a subaltern at the commencement of the Revolution. He then attained the rank of captain, in which capacity he made his first campaigns, acting as aide-de-camp to General de Lamarche, and afterwards as adjutant-general under the orders of Kléber. This latter employment afforded him several opportunities of distinguishing himself; and, in the official reports of the time, honourable mention is made of him at the passage of the Lahn in 1795, and also at the combats of Altenkirchen, Montabaur, and Wurtzburg. On the 8th of August 1796, he took Pfortzheim, and was promoted to the rank of brigadier-general. In the campaign of 1797, he was again successful; but his horse having been killed at the combat of Steimberg, he fell into the hands of the enemy. Hoche, who admired his undaunted courage, earnestly solicited his exchange, and, as soon as he had obtained it, appointed him general of division. It was in this capacity that, in 1798, Ney commanded the cavalry of the army which, under the orders of Schaumbourg, executed the invasion of Switzerland. On this occasion he acted towards the inhabitants with as much generosity as circumstances would permit; and, the following year, he acquired a great reputation under Massena, particularly at the battle of Zurich. In the year 1800 he served with the army of Moreau, and greatly distinguished himself both at Moeskirch and at Hohenlinden. After the peace of Luneville, when Bonaparte wished to effect the entire subjugation of Switzerland, Ney was sent into that country with the title of minister plenipotentiary, and there conducted himself in a manner to deserve more and more the favour of his master. In 1804 he obtained the baton of marshal of the empire; and it was in this capacity that, in 1805, he gained, in Suabia, the victory which procured him the title of Duke of Elchingen. After the capitulation of Ulm, being ordered to occupy the Tyrol, he entered Innspruck on the 7th of November, at the head of the sixth corps of the grand army, which he also commanded the following year, in the contest with Prussia. Having contributed essentially to the victory of Jena, he appeared before Magdeburg, and, by a prodigy which still remains inexplicable, he, in less than twenty-four hours, received the capitulation of that redoubtable fortress, defended by a numerous garrison. In the beginning of 1807, he obtained a signal success before Thorn, where the whole Russian army had advanced to attack him, hoping to surprise him in his winter quarters; and, at a later period, he carried the town of Friedland at the battle of that name, which terminated the war in the north of Europe. But the war in which Napoleon found himself involved, if extinguished at one point, was assiduously kept alive at others. Scarcely had he concluded a peace with the Russians at Tilsit, when he hurried away to attack the Spaniards; and Marshal Ney, with his corps d'armée, was transported from the banks of the Niemen to those of the Ebro and the Tagus. The marshal, finding himself obliged to carry on a war of posts and of chicane in Galicia, lost a great number of men in this inglorious service, and with difficulty maintained his ground till the moment when he received orders to unite his corps with that of Massena, who had been sent in order to expel the English from Portugal. But this was found to be impracticable. It was judged that the lines of Torres Vedras could not be attacked with any prospect of success; and when Massena found himself constrained to retire before the Duke of Wellington, Ney commanded his rear-guard, and, in that difficult retreat, displayed equal talent and courage. In 1812, he was recalled by Napoleon to assist in the approaching invasion of Russia, for which an army of more than four hundred thousand men had been assembled on the Vistula. At the terrible battle of Mojaïsk or Borodino, Ney commanded the centre; and it was on this occasion, amidst the carnage of a conflict unequalled in modern times, that he earned the title of Prince of Moskwa. Nor did he display less valour and firmness in the disastrous retreat from Moscow, in which his corps almost entirely perished. Napoleon, who commonly called him the bravest of the brave, then designated him, in one of the bulletins of the army, as having a soul tempered with steel. In 1813, Ney participated in the indecisive victories of Lutzen and Bautzen; but he had the misfortune to lose the battle of Dennevitz, where he was defeated by Bernadotte and Bulow, with the loss of ten thousand prisoners and eighty pieces of cannon. This event made a deep impression upon his mind. Napoleon testified the most marked displeasure; and Ney, dissembling his chagrin, returned to Paris in a sort of disgrace. Nevertheless, he was again employed in the beautiful but unfortunate winter campaign of 1814; and he was at Fontainebleau when Napoleon was compelled to abdicate. Ney contributed materially to bring about this event, and he was one of the first generals who submitted to the Bourbons. Having presented himself before Monsieur on the 12th of April, he said to that prince, "Your royal highness will see with what fidelity we can serve our legitimate king." He also went to pay his respects to the king at Compiègne, and was there most favourably received. Louis XVIII. himself received his oath as a chevalier of the order of Saint-Louis, confirmed to him all his titles and pensions, and created him a peer of France. Marshal Ney was living at his estate of the Coudreaux when Napoleon, having escaped from the island of Elba, landed on the coast of France in February 1815; and he there received orders from the minister of war to repair to his government of Besançon. He immediately proceeded to Paris, and presenting himself before the king, made great protestations of devotion, and, kissing the hand of Louis, declared to him that he would bring back the disturber of Europe in an iron cage. He then set out for the eastern frontier, assembled some regiments at Besançon, and placing himself at their head, proceeded towards Lyons. At Lons-le-Saulnier, however, he learned that Napoleon had already entered Lyons; and from this time great agitation manifested itself amongst the troops. Nevertheless, the marshal himself still appeared faithful to the king, and even exerted himself to calm the excitement which prevailed amongst the troops; but in the night between the 13th and 14th of March, an emissary sent by General Bertrand brought him proclamations and letters from Napoleon, who made him brilliant promises, and styled him, as formerly, the bravest of the brave. The marshal could not resist the seductions of his old master, and next day he read to the troops his famous proclamation, beginning with these words: "The cause of the Bourbons is for ever lost. It is the Emperor Napoleon, our sovereign, who is alone entitled to reign." His whole conduct during the hundred days was a consequence of this step. Napoleon sent him as extraordinary commissioner to survey the frontiers of the North, and also appointed him a member of his chamber of peers. In the short but decisive campaign of Waterloo, he displayed none of the military qualities for which he had been distinguished, except courage. At Quatre-Bras he acted with unaccountable hesitation, paralysing a force sufficient to turn the scale on either side, but which, in reality, effected nothing of the least importance. After the defeat of the French army at Mont St Jean, he returned to the capital, and in the chamber of peers gave a most alarming picture of the disaster which had befallen it. When Paris capitulated, Ney, having no hopes of finding favour with the Bourbons, took refuge in Auvergne, where he was arrested in consequence of the ordonnance of the 24th of July, in which he was described as one of the authors of the revolution of the 20th March. Being conducted to Paris, he was confined in the Conciergerie, subjected to several interrogatories, and at length brought before a court-martial, composed of marshals of France and lieutenant-generals, to whose competency he objected. His counsel insisted much upon this point, in which they were ultimately successful; the members of the court being glad to escape from an embarrassing position, by pronouncing their own incompetence to try the prisoner. By an ordonnance of the king, Ney was then brought before the court of the peers, whose competency was not disputed. But his counsel remonstrated warmly against the expressions employed by the ministers, who had declared that it was "in the name of Europe" that they demanded his trial; and the same learned persons appealed with much force and eloquence to the conditions of the capitulation of Paris, which guaranteed to all who were within the walls of the capital that they should neither be disturbed nor sought after on account of their political conduct. All their efforts to save their client were, however, unavailing. After fifteen sittings, Marshal Ney was condemned to death, on the 6th of December 1815, by a majority of 160 to 119; and the following day the sentence was carried into execution. Having received all the consolations of religion from the curate of Saint-Sulpice, he was shot by a platoon of veterans, near the palace of the Luxembourg, where he had been condemned, and displayed in his last moments the same heroic courage which had so often distinguished him in the field of battle. His body was given to his friends, and conveyed to the cemetery of Père la Chaise, where his tomb may now be seen. Marshal Ney and Colonel Labédoyère were the only victims of a revolution where it is evident that neither played the principal part, and that both were led away by the force of circumstances, and the spell which Napoleon exercised over the minds of the officers as well as the common soldiers of the army. (A.)

NEYER, a district of Hindustan, in the province of Cutch, situated about the twenty-fourth degree of north latitude, and bounded on the south-east by the fenny tract called the Runn. The country has been but imperfectly explored, and is of an arid and sandy nature, being intersected by no streams or rivers. Water is procured from deep wells, which in many seasons afford but a precarious supply. The inhabitants are generally thieves and depredators. The country abounds in horses of a very superior quality, which enables the plundering rajpoots to extend their ravages far and wide. The Coolies, also, who inhabit this tract, are very curiously armed with a curved stick like the blade of a sabre. This is burnt and made extremely hard, and thrown to the distance of 120 yards, at which distance they can break a man's leg, or kill him if they strike him on the head.

NGANCHAN, a city of the first rank, in Koeitchoo, being situated in a mountainous country, which, owing to the rudeness of the inhabitants, is in an unimproved state. Long. 105. 31. E. Lat. 26. 12. N.

NGANLO, a town of China, of the first rank, in Houquang, being situated on the river Han, in an extensive and fruitful plain. It carries on a considerable trade. Long. 111. 24. E. Lat 31. 14. N,

NHING-KOUE, a city of China, of the first rank, in the western part of the province of Kiangnan, being situated in a mountainous and woody country, abounding in medicinal plants. It has considerable manufactures of paper. Long. 118. 24. E. Lat. 31. 2. N.

NIAGARA, a large river of North America, to which belong the most magnificent water-falls in the world. The river, forming part of the boundary line between New York and Upper Canada, runs from Lake Erie into Lake Ontario, thus connecting the St Lawrence and Lake Ontario with the upper lakes. It is thirty-five miles in length, and is from half a mile to several miles in breadth. There are many islands in the Niagara, all the way to the falls, and close above them; but the principal island is about half-way between the village of Black-Rock and the falls; it is called Grand Island, and contains about 17,000 acres. The river is about two miles and a half in width below Grand Island, and there the current increases; but it becomes more contracted on its way to the falls. The rapids succeed, which are swift currents, occasioned by great descents of the river, tumbling perpendicularly, in some places six, eight, and ten feet, over ledges of rock, the whole descent being about sixty feet. From Fort Erie on the Canada shore, at the outlet of Lake Erie, to Chippewa (eighteen miles), the bank is from four to ten feet high. From Chippewa to the Great Fall, two and a half miles along the Canada shore, there is a descent of ninety-two feet, and the bank is from ten to one hundred feet in height. The river is here so rapid, that notwithstanding its great depth, it is always covered with a white foam. From the cataract to Lewiston is seven miles; and near this place the bank is 310 feet high, being composed of strata of soft mud and sand, clay, gypsum, slate, limestone, and a superstratum of earth. From Lewiston to Lake Ontario is seven miles, and in this distance the northern terrace or mountain ridge crosses the course of the river. The height of the bank then diminishes to twenty-five or thirty feet. The difference of level between Lakes Erie and Ontario, forming the whole descent of the river, is 334 feet. The Niagara affords a great variety of fish, such as sturgeon, bass, muscanunge or muscalunga; and salmon-trout are numerous below the falls. The white fish, weighing from two to six pounds, are taken in seines, from October to May.

The stupendous Falls or Cataracts of Niagara are situated about half way between Lakes Erie and Ontario. Although mere description can convey no adequate idea of the momentum of the Niagara, some notion of it may be formed when we reflect that the descent above the falls is about sixty feet in half a mile; that the column of water is three quarters of a mile in breadth and twenty-five feet in depth; and that it is propelled onward, not only by its own gravity, but by the weight of the whole surplus waters of the immense inland seas of North America. Two small islands, Bath Island and Goat Island, intervene on the American side, very near the falls, and separate the river into two branches, the great mass of water descending by the more direct and wider channel on the western or Canada side, by what is called the Horse-shoe Fall. A portion of the fall on the American side is cut off by a small island on the precipice; the rest descends in one vast body, almost perpendicularly, from a height of 164 feet, its breadth being about 220 yards. Both the falls on the American side are crossed by bridges. The Horse-shoe Fall is several feet less in height; but it far surpasses the other in grandeur. Its breadth is estimated at 600 yards, and seven eighths of the waters of the river are supposed to pass over it. This great body of water sweeps over the precipice with such tremendous force that it forms a curved sheet, which strikes the surface of the water beneath fifty feet from the base of the precipice, so that visitors may venture to pass behind this watery wall. The best points of view are from the Table Rock, which projects and looks over the falls; and here the cataracts on both sides may be seen at once. But the rapids are beheld to the greatest advantage from Goat Island, to which a very ingeniously constructed and strong rough bridge has been thrown on the American side, over great blocks of rock and rapids. The river is crossed by a small boat about two hundred or three hundred yards below the falls, where it is about 1200 yards in breadth. There is a steep wooden stair from the landing-place to the top of the bank on the American side; and from thence, by the bridge over the rapids, already mentioned, Goat Island may be readily approached. "On the north side of that island," says Mr Stuart, "the rocks, projected into the river, two hundred or three hundred feet immediately over the falls, are accessible by a rough wooden bridge, below which the water runs with fearful velocity. From these rocks, the view over the precipice and great fall is terrific, absolutely appalling, although the prodigious magnitude of the tumbling water is not so apparent at this spot as from the Table Rock and the boat." A spiral stair-case conducts to the edge of the river below the Table Rock, and from a point a little way nearer the falls than the foot of the ladder there is an excellent view. "The overwhelming sensations," continues the traveller above named, "with which a spectator can hardly fail to be affected, are produced by the immense flood, not less than one hundred millions of tons of water per hour, the stupendous mass, and overpowering force of the roaring and falling waters. It is, in truth, a great deep ocean thrown over a precipice nearly 160 feet high. Every thing, every surrounding object, is viewed with indifference, whilst the mind is wholly absorbed in the contemplation of a spectacle so sublime, surpassing in majesty, and grandeur, and power, all the works of nature which have ever arrested the attention, or presented themselves to the imagination. No just or adequate description can be conveyed by language. Such words as grandeur, majesty, and sublimity, fail altogether to express the feelings which so magnificent a sight, exceeding so immeasurably all of the same kind that we have ever seen or imagined, excites." Mr Stuart gives just praise to the following description of Mr Morris, an American minister, which appears to be as simple, plain, and intelligible as a mere verbal picture of the spectacle can be. "To form," says this individual, "a faint idea of the cataract, imagine to yourself the Frith of Forth rush wrathfully down a steep descent, leap foaming over a perpendicular rock 175 feet high, and then flow away in the semblance of milk from a vast basin of emerald." The great volume of water, as we have said, inclines very much forward in its descent, and it falls, for the most part, in an unbroken sheet of a dark-green colour, until it meets a cloud of spray ascending from the rocks below, in which it is lost to the eye. This cloud of vapours, the "everlasting incense of the waters," as it has been finely designated, rises a hundred feet above the precipice, and can be seen at the distance of seventy miles. Prismatic colours are always present, and complete rainbows, sometimes three at a time, of the most brilliant hues, are not unfrequently "set in the cloud." The thunder of the cataract can be distinctly heard at ten miles from the falls, and in favourable states of the wind and atmosphere at even twice that distance. With regard to the height of the fall, there is a discrepancy amongst authorities, some calling it 150, others 160, and a third class of writers carrying it up as far as 176 feet. It appears to us that some calculate from the surface of the column of water, some from its medium depth, and some from its base, just as it bends over the incurvated precipice. This view of the matter reconciles them all, the largest number answering to the top of the column of water, and the lesser numbers to its average depth and the height of the precipice. The Niagara is usually frozen over during a part of the winter, except at the falls, and where the rapids are most violent. At this season of the year, myriads of wild ducks alight on the foaming stream above the falls, and, sailing on the bosom of the cataract until it reaches its extreme circular verge, at about half its descent, rise aloft into the air amidst the spray of the "phlegethon" below, wheel round to the place on the rapids whence they began their descent, and again perform with ease and for pastime what bids defiance to the utmost power and ingenuity of man. (R. R. R.)

NIAGUR, a town of Hindustan, belonging to the Nagpoor Mahrattas, and situated in the province of Gundwana, twenty-eight miles north-north-west from Ruttunpoor. Long. 82. 11. E. Lat. 22. 22. N.

NIAS ISLE. See Neas Isle.

NICANDER, a Greek physician of the empirical sect, and also a poet and grammarian, was a native of Colophon, and, according to some authors, had been a priest of Apollo at Claros in Ionia. The date of his birth is uncertain; but it is probable that he died about a century before the commencement of our era. His father's name was Damnæus, and he was sometimes called an Ætolian, because he appears to have lived during many years in Ætolia, and to have written a history of that country. This physician occupied himself much with materia medica and pharmacy, and composed his works in verse. The greater part of his

Nicander.

writings, however, which are said to have been numerous, is no longer extant. One of his poems, entitled *Georgica*, which he dedicated to Attalus III. the last king of Pergamus, is cited with commendation by Cicero in his treatise *De Oratore* (lib. i. c. 16). In some others of his lost works, which were also in verse, he appears to have described the various poisons and their antidotes; at least such is the statement of Eustathius and Athenæus. Of his various poems two only remain; the *Theriaca* and *Alexipharmaca*.

The *Theriaca*, though composed without critical discernment, contains, nevertheless, some remarkable facts in natural history. In it may be found an exact but somewhat prolix description of the combats of the rat of Pharaoh, or mangouste (*viverra ichneumon*), with the serpents, the flesh of which is eaten by that quadruped with impunity. The author also treats of scorpions, which he divides into nine species; a division adopted by some modern naturalists. His description of the *amphisbæna* accords with that which has been given by Linnæus in his *Amœnitates Academicæ* (tom. i.). Then follow some very curious observations on the effects of the poison of different kinds of serpents, each of which produces different phenomena. Nicander thought he had ascertained that the poison of serpents is concealed in a membrane surrounding the teeth; an opinion which is not very far from the truth. He describes a species of serpent which always takes the colour of the soil on which it crawls, and which he denominates σηψ. He was the first who distinguished night-butterflies from those which are seen only during the day; and to the former he gave the name of *phalænæ*, which they still bear. This poem contains a great number of popular fables, which, however, were all firmly believed at a period when the science of natural history was in its infancy. Thus we find it gravely stated that wasps are produced by the putrefied flesh of horses. As to the poem entitled *Alexipharmaca*, it may be considered as a continuation of the preceding. The effects of poisons are there explained with tolerable accuracy. They are divided into animal, vegetable, and mineral; but under the last head Nicander only mentions white lead, and litharge, which is also an oxide of lead.

Of these two works there have been numerous editions. The first, which is in folio, was published at Venice in 1499; and the next, in quarto, appeared at Cologne in 1530, with an interpretation of the *Theriaca*, and various commentaries on the *Alexipharmaca*, by an anonymous annotator. Of both there have been various Latin translations, some into prose and others into verse; but the principal are those of Lonicer, Cologne, 1531, in 4to; Erycius Cordus, Francfort, 1572, in 4to; Jean de Gorris, Paris, 1549, in 8vo; and Pierre-Jacques Stève, Valence, 1552, in 8vo. Lastly, the works of Nicander were translated into French by Jacques Grévin, Antwerp, 1567, 1568, in 4to. In the Imperial Library at Vienna there is a beautiful manuscript copy of both poems, ornamented with figures of venomous animals, and accompanied by a commentary from the pen of the sophist Euteichnius, which has been printed in the Greek edition of Nicander published by J. G. Schneider, Halle, 1792, in 8vo. Demetrius Phalereus, Theon, Plutarch, and Diphilus of Laodicea, all wrote commentaries upon the *Theriaca*; and there are still extant learned Greek *scholia* on both poems, which Vossius has ascribed to Diphilus, though upon what authority we know not. Besides the poems above mentioned, Nicander also wrote in verse *Ophiaca*, or a treatise on serpents; *Hyacinthia*, or a collection of remedies; and a commentary on the Prognostics of Hippocrates. He was likewise the author of five books of Metamorphoses, some verses of which have been preserved by Tzetzes; and he wrote in prose several historical works, one of which, being the history of Colophon, is cited by Athenæus, whilst the others mentioned are accounts of Ætolia, Bœotia, Thebes, and a general description of Europe. This Nicander has sometimes been confounded with a grammarian of the same name, a native of Thyatira; and Vossius, in giving the titles of the works written by both, has not been careful to distinguish clearly their respective productions. Mérian, in his essay on the Influence of the Sciences on Poetry (see Memoirs of the Royal Academy of Berlin for 1776), cites the works of Nicander, as affording evidence of the incongruity which exists between the language of poetry and the nomenclature of science; and stigmatizes the author of the *Theriaca* as a therapeutic versifier, who wrote lines for the apothecaries, and a mere grinder of anecdotes, who sung of toads, scorpions, and spiders. In the *Bulletin de Pharmacie* for 1810, however, M. Cadet de Gassicour has given an analysis of the works of Nicander, affording materials for a more accurate judgment than the exaggerated and burlesque representations of Mérian. (A.)

Nicander
St
||
Nicaragua.

NICANDRO, St, a city of the kingdom of Naples, in the province of Capitanata. It stands on the river Gargano, and contains 7090 inhabitants.

NICARAGUA, one of the five states which compose the republican confederation of Central America. It is bounded on the south by Costa Rica and by the Pacific Ocean; on the north by Honduras; on the west by the Pacific Ocean; and on the east by the Mosquito shore, which is washed by the Carribbean Sea. From north to south it extends about seventy-five leagues, and from west to east about eighty-five. That elevated mountain range which forms the spine of the whole continent, called in South America the Andes, and in the United States the Stony Mountains, may be traced throughout Central America, although at a smaller elevation than in the two adjoining continents, dividing this country into two grand portions; the waters on the north of the ridge falling into those of the Atlantic, and those on the south running into the Pacific. This range has in Central America no determined name, and in many parts is even without a visible existence. It may almost be said to be interrupted in its course by two transverse valleys, in one of which is contained the Lake of Nicaragua, and in the other the plain of Comayagua. "But this interruption," says Colonel Galindo,[1] "is more apparent than real; for to the southward of the lake there certainly exists an elevation, which separates its waters from the Pacific; and in the extensive valley of Comayagua, the only one of the union which runs north and south, there is decidedly a central eminence, on each side of which the waters drain off to the respective oceans." In the state of Nicaragua, the mountain chain inclines close to the borders of the Pacific, leaving the lakes on the east. The climate of this state is hot, and it yields excellent grapes and other fruits, cocoa, indigo, cotton, the gum called *cavana*, and various medicinal drugs. But the productions of the cold or temperate zones, such as wheat, do not thrive, and the soil is not favourable for breeding sheep. Immense herds of cattle, however, are pastured in the large grazing farms, for the consumption not merely of the province, but also of the city of Guatemala.

The most remarkable feature of this province consists in its numerous rivers and immense lakes. The Lake of Nicaragua, the largest sheet of water in Central America, is about 150 English miles in length, and about sixty in breadth. It has almost everywhere a depth of ten, and sometimes of fifteen fathoms, with a muddy bottom, except along the shore, where there is clear sand. This vast basin receives a number of rivers; but the only visible outlet to its waters is the river St John, which flows into the Atlantic, and forms about thirty considerable falls before

[1] Journal of the Geographical Society of London, vol. vi. part ii. 1836.

Nicaragua. it reaches the marshy shores of the ocean. On the north-west it communicates with the Lake of Leon or Managua (upwards of fifty miles in length and nearly thirty in breadth) by means of a navigable channel called the Rio Tapitapa, about twenty miles in length. With regard to the grand canal by which it is proposed to connect the Atlantic with the Pacific through the Lake of Nicaragua, the following is the most recent information on this very interesting and most important subject.[1] "It would be an important service rendered to geography, would any person endeavour to ascertain the levels on this line of road, and the physical obstacles it would be necessary to overcome to form a water communication. It is believed that some such survey has been set on foot by the government, or by a company of the United States. In the mean time, the only observations we have are from a Spanish manuscript existing in the archives at Guatemala, and copied by Mr Thomson,[2] which states that the engineer Don Manuel Galisteo executed a survey in the year 1781, by means of a water-level, from the Gulf of Pagagayo, in the Pacific, as far as the Lake of Nicaragua; and that, by 347 levels, at about 100 yards apart, the surface of the lake was found to be elevated 133·11½ feet above the sea. But the lake is said to be fifteen fathoms deep, so that its bottom is still forty-six Spanish feet (one Castille foot is 0·9267 of an English foot) above the level of the South Sea. The distance between the lake and the sea, at the proposed communication, is, by this measurement, only 29,880 English yards, or fifteen geographical miles nearly, and the greatest actual height of any part of the land is nineteen feet above the level of the lake. Thus we are assured of a grand natural reservoir of water at a sufficient elevation. But the practicability of communication with the Pacific, either by this line or through the Lake of Leon, or with the Atlantic by the Rio San Juan, or some great transverse valley, is not yet ascertained with any certainty. The coast-line has hitherto been very imperfectly laid down on our maps; but the recent survey of Captain Owen, R. N. now in progress, will doubtless remedy this for the northern coast." It is also expected that the survey of Captain Beechey, R. N. on the coast of Peru, will reach this coast, and correct the errors which exist in all the maps of it that are to be met with. With regard to the undertaking itself, it appears to us insignificant, when compared with some of those which are frequently engaged in and successfully accomplished by the Americans of the United States, where canals sometimes five hundred miles in length are cut, and not unfrequently to a considerable extent through the solid mountain rock. We have no doubt that ere long this speculative and enterprising people will set this great work on foot, which will doubtless cause a revolution in the commercial world, and prove of incalculable utility to it. There are a number of islands on the Lake of Nicaragua; but the only one inhabited is Ometepe, and it is also the only one on which a volcano is found. This lake is subject to violent agitations from tempestuous gales of wind. The lakes, rivers, and coasts, both on the Atlantic and Pacific Oceans, furnish an inexhaustible supply of various kinds of fish. The surrounding country is well wooded, and much valuable timber, affording dye-woods and gums, is found in the forests; amongst these may be mentioned the dye-wood which is known by the name of the state. Some of the most populous villages of Nicaragua are likewise found in its vicinity.

Of the numerous volcanic eruptions which have taken place in Central America, one of the most appalling on record is that of the volcano of Cosiguina, situated in Nicaragua, near the eastern promontory of the Bay of Conchagua, which separates the waters of the gulf from the Pacific. This took place in January 1835; and as no convulsion of the kind ever occurred before on the same spot, it was quite unexpected. On the 16th and 17th of that month, continued noises were heard at a great distance all round, and were supposed at first to be caused by artillery; but during the following ten days, the violent earthquakes, the fall of showers of pumice-stone and ashes, and the deep darkness which overspread the country and the contiguous sea for many leagues, pointed out the true cause. The official report from the city of Leon states, that there, and in the department of Granada, "the catastrophe was not perceptibly felt until the dawn of the 25th, when the eruption developed itself to such a degree that the sky was darkened, and continued to deepen till eleven in the morning, when the district was enveloped in the most fearful darkness, terrific reports being at the same time heard, and showers of calcined lava being precipitated over the whole face of the country." In other parts of the state, the same train of phenomena occurred, accompanied with the loudest thunder and the most vivid lightnings, together with violent convulsions of the earth. Two islands and a number of shoals were formed in the sea; the river Chiquito, which flowed towards the north-west, was completely choked up, and another river made its appearance flowing in an opposite direction. Two farms, along with a great quantity of live stock, were destroyed; and within the limits of the eruption there were afterwards found the remains of all kinds of quadrupeds and birds. Few of the human species, however, perished; and the damage done was inconsiderable, considering the tremendous nature of the eruption, an idea of which may be formed from the fact, that the sound was heard and ashes fell at Jamaica, more than 800 miles from Cosiguina. At sea, clouds of dust were discovered floating at a far greater distance from the scene of the catastrophe.

The city of Leon, the capital of the state, is situated in a savannah, about eight leagues from the western shore of the Lake Leon, and four leagues from the shores of the Pacific, in latitude 12. 20. north, and longitude 86. 16. west. It was originally founded in 1523, on the spot now called Old Leon, but was rebuilt on its present site a few years afterwards. Previously to the revolution it was populous, and rapidly increasing in prosperity; but, along with the whole of the state, it suffered severely in that struggle, and has not yet recovered from its effects. Four leagues to the north-west of Leon, on the shores of the Pacific, is the town of Realejo, inhabited entirely by Ladinos, who are chiefly employed in ship-building. The harbour, formed by a large and beautiful river, is excellent, and capable of containing 1000 vessels commodiously. The conveniences for ship-building are great, as timber, cordage, sail-cloth, pitch, and tar may be procured to an almost unlimited extent. The supply of masts is also inexhaustible. The town was built in 1534, by the companions of Alvarado, in his expedition to Peru, who, observing the advantageous situation of the harbour, determined to establish themselves on a spot so convenient and promising. At a short distance is the village of the Viejo, where the corregidors formerly resided, on account of the salubrity of its situation. The principal place in the vicinity of the Lake of Nicaragua is the town of Granada. This city was founded in the year 1523. It stands on the north-western shore, in an advantageous position for commerce (latitude 11. 30. north, and longitude 86. 21. west), being distant from Leon about thirty leagues. This place contains about 6000 inha-

[1] Journal of the Geographical Society of London, vol. vi. part ii. 1836.
[2] Thomson's Visit to Guatemala in 1825, London, 1829.

bitants. The town of Nicaragua, situated twelve leagues south-east of Granada, is inhabited by the descendants of Spaniards, who carry on a traffic in cocoa. But the place which is said to carry on the largest trade is Masaya, situated at the bottom of a deep rocky dell. The situation of this village was certainly ill chosen; water is very scarce, and the inhabitants are compelled to bring it up in pitchers from a well of extraordinary depth. Besides, at a short distance from Masaya is the volcano of the same name, now indeed extinct, but at the time of the conquest known by the name of the Infierno de Masaya; and the light of the lava constantly boiling up in the crater might be perceived at sea twenty-five leagues. Not far from this there is another volcano, called Nindiri, from which an eruption took place in 1775, when "the torrent of lava that rolled into the Lake of Masaya destroyed the fish, and heated the lands which it traversed to so great a degree that all the cattle feeding on them perished." The only other places of any consideration in the state are Segovia Nueva, situated on the river Yare, near the confines of Tegucigalpa, thirty leagues north of Granada; Esteli, Acoyapa, Villa Nueva, Subiana, a very populous Indian village contiguous to the city of Leon, and Nicoya. The cities, towns, and villages in Nicaragua, and the other states of Central America, have municipalities, the members of which are annually elected, and the alcaldes or chief justices preside. Each of the states is governed by a chief. The inhabitants are chiefly Roman Catholics, but the monkish orders have been wholly extinguished, and the few nunneries which remain cannot compel their members to stay in them against their will. In 1836 Colonel Galindo estimated the number of inhabitants at 120,000 Indians, 110,000 whites, and 120,000 Ladinos; the total being 350,000 souls.

Nicaragua was the first province subdued by the Spaniards, having been discovered and partially settled by Gil Gonzales Davila and his companions in 1522. It takes its name from a powerful cacique, who was one of the first to enter into amicable relations with the Spaniards, and submit to baptism. The indigenous natives of Nicaragua speak five different languages. The Chorotec seems to be that of the principal indigenous tribe. It bears no kind of affinity with the Aztec or Mexican, which had been rendered common, previously to the arrival of the Spaniards, by the invasion of an Aztec colony. These new comers used a species of hieroglyphical figures for the communication of ideas, but the Chorotecs would seem to have been ignorant of writing. They reckoned eighteen months in the year, and had an equal number of great festivals. Their idols were honoured with a sanguinary worship like those of Mexico, and their women were liable to be offered in sacrifice, although otherwise they exercised considerable power. The Spaniards, on their arrival, discovered palaces and spacious temples, and found some expert workers in painter's gold. The bulk of the people, however, were in a state of barbarism and abject misery. (R. R. R.)

NICARIA, an island of the archipelago, between Samos and Tine, about fifty miles in circumference. A chain of high mountains, covered with wood, runs through the middle, and supplies the country with springs. It produces wheat, barley, figs, honey, and wax.

NICASTRO, a city of the province of Calabria Ulteriore, in the kingdom of Naples, being situated on the river Polito, in a district abounding in olives, and yielding rice, wheat, and other corn, with excellent wine. It is surrounded with walls, and contains 6100 inhabitants.

NICE, a part of the continental dominions of the king of Sardinia, and usually distinguished as a countship. It extends in east longitude from 6. 27. to 7. 51. and in north latitude from 43. 45. to 44. 28., and contains 1430 square miles. It is divided into four provinces, viz. Nice, Sospello, Oneglia, and Monaco; and it is said to contain 200,000 inhabitants. The city of Nice is the capital of the countship, as well as of the province of its own name. It is situated on the shore of the Mediterranean, in the Gulf of Genoa, where the Paglion falls into the sea. It has an artificial haven, capable of containing 200 vessels, and is protected from the waves by a long mole. It is fortified both towards the land and towards the sea. It contains narrow, gloomy, and filthy streets, but, from some of the terraces on the shore, it has fine prospects towards the sea, including the hills near Genoa, and the distant mountains of Corsica. It contains a cathedral, two parish churches, fifteen monasteries, four nunneries, several oratories, and two hospitals, with 2000 houses, a few of them very magnificent, with 19,645 inhabitants. There is an extensive trade in silk, and in liqueurs, essences, perfumes, and soaps; and the fishery is a considerable source of employment. It was the birth-place of the painter Vanloo, and of the celebrated mathematician Cassini. Long. 7. 10. E. Lat. 43. 41. N.

NICEPHORUS, Gregoras, a Greek historian, was born about the close of the thirteenth century, and flourished in the fourteenth, under the Emperors Andronicus, John Palæologus, and John Cantacuzenus. He was a great favourite of the elder Andronicus, who made him librarian of the church of Constantinople, and sent him as ambassador to the Prince of Servia. He accompanied this emperor in his misfortunes, and assisted at his death, after which he repaired to the court of the younger Andronicus, where he seems to have been well received; and it is certain that, by his influence over the Greeks, that church was prevailed on to refuse entering into any conference with the legates of Pope John XXII. But in the dispute which arose between Barlaam and Palamos, he took part with the former, and maintained his cause zealously in the council held at Constantinople in 1351. For this he was cast into prison, and continued there till the return of John Palæologus, who released him; after which he held a disputation with Palamos, in the presence of that emperor. He compiled the Byzantine history from 1204, when Constantinople was taken by the French, to the death of Andronicus the younger, in 1341; a work which is not only barbarous in style, but inaccurate in facts. This history, with a Latin translation by Jerome Wolf, was printed at Basil in 1562, and again at Geneva in 1615; but a more correct edition than either of the preceding is that which was printed at the Louvre in 1702, by Boivin, in two vols. folio. Nicephorus was the author of several other works, all of which remain inedited, excepting his *Scholia* upon the treatise of Synesius *de Insomniis*, which were published by Turnebus in 1553.

Nicephorus, *Calistus*, a learned monk of Constantinople, who flourished in the fourteenth century, under the Emperor Andronicus Palæologus the elder. He wrote in Greek an ecclesiastical history in twenty-three books, eighteen of which are still extant, and contain the transactions of the church from the birth of Christ till the death of the Emperor Phocas in the year 610. Of the other five books we have nothing but the arguments, which show that they embraced the portion extending from the commencement of the reign of the Emperor Heraclius to the end of that of Leo the Philosopher, who died in the year 911. This history was dedicated to Andronicus Palæologus the elder; it was translated into Latin by John Langius, and has gone through several editions, the best of which is that of Paris, published in 1630.

NICERON, John Francis, a French mathematician, was born at Paris in the year 1613. Having finished his academical studies, he entered into the order of the Minims, and took the habit in 1632; and, as is usual, he changed the name given him at his baptism for that of Francis, the name of his paternal uncle, who was also a Minim, or Franciscan. His inclination and taste for the mathematics appeared early during the course of his philosophical studies; and to that science he devoted what time he could spare from his other employments, after he had completed his studies in theology. All the branches of the mathematics, however, did not equally engage his attention; he confined himself particularly to optics, and only learned as much of the rest as was necessary for rendering him perfect in this branch. He has himself informed us, in the preface to his *Thaumaturgus Opticus*, that he travelled twice to Rome, and that, on his return home, he was appointed teacher of theology. He was afterwards chosen to accompany Father Francis de la Noue, vicar-general of the order, in his visitation of the convents throughout France. The eagerness of his passion for study, however, induced him to make the best use of all the moments he had to spare, and that wise economy of time furnished him with as much leisure as satisfied his love of knowledge. Being taken sick at Aix, in Provence, he died there on the 22d of September 1646, at the early age of thirty-three. He was an intimate acquaintance of Descartes, who had a high esteem for him. The principal works of Niceron are, 1. L'Interpretatioh des Chiffres, ou Règles pour bien entendre et expliquer facilement toutes sortes des Chiffres simples, Paris, 1641, in 8vo; 2. La Perspective Curieuse, ou Magie Artificielle des effets merveilleux de l'Optique, Catoptrique, et Dioptrique; 3. Thaumaturgus Opticus, sive admiranda Optices, Catoptrices, et Dioptrices, pars prima, 1646, in folio, a work to which the preceding essay was intended to serve as an introduction.

Niceron, *John Peter*, justly celebrated on account of his Biographical Memoirs, was born at Paris on the 11th of March 1685. He was descended of an ancient and noble family, which was in very high repute about 1540. He studied with success in the Mazarin College at Paris, and afterwards at the college of Duplessis. Having resolved to forsake the world, he consulted one of his uncles, who belonged to the order of Barnabite Jesuits. This uncle examined him, and not doubting his election, introduced him as a probationer to that society at Paris. He was received in 1702, took the habit in 1703, and made his vows in 1704, at the age of nineteen. After he had professed himself, he was sent to Montargis, in order to study philosophy and theology; and his superiors, being satisfied with his proficiency, sent him to Loches, in Touraine, to teach the classics and rhetoric. Here his devout behaviour and excellent conduct as a teacher made him be thought worthy of the priesthood, which he received at Poitiers in 1708; and as he had not arrived at the age to assume this order, a dispensation was obtained in his favour. The college of Montargis having recalled him, he there professed rhetoric for two years, and philosophy during four. Notwithstanding all these avocations, he was humanely attentive to every call of charity, and to the instruction of his fellow-creatures, many of whom heard his excellent discourses, not only in the pulpits of the churches within the province, but even in those of Paris. In 1716, his superiors invited him to the city, that he might have an opportunity of prosecuting with more convenience those studies for which he had always expressed the greatest inclination. He understood not only the ancient, but also the modern languages; a circumstance of infinite advantage in the composition of those works which he has given to the public, and which he carried on with great assiduity till the time of his death, which happened on the 8th of July 1738, at the age of fifty-three. His works are, 1. Le Grand Fébrifuge, or, a Dissertation to prove that common water is the best remedy in fevers, and even in the plague (translated from the English of John Hancock, minister of St Margaret's, London), in 12mo. This little treatise made its appearance, amongst other pieces relating to this subject, in 1770, and was attended with such success that it passed through three editions, the last of which appeared in 1730, in two vols. 12mo. 2. The Voyages of John Ouvington to Surat, and divers parts of Asia and Africa, containing the history of the revolution in the kingdom of Golconda, and some observations upon silk worms, Paris, 1725, in two vols. 12mo. 3. The Conversion of England to Christianity, compared with its pretended Reformation, a work translated from the English, Paris, 1729, in 8vo. 4. The Natural History of the Earth, translated from the English of Mr Woodward, by M. Nogues, doctor in physic, with an answer to the objections of Dr Camerarius, and containing also several letters written on the same subject, with a methodical distribution of fossils, translated from the English by Niceron, Paris, 1735, in 4to. 5. Memoirs of Men illustrious in the Republic of Letters, with a critical account of their works, Paris, in 12mo. The first volume of this great work appeared in 1727; and the others were given to the public in succession, as far as the thirty-ninth, which appeared in 1738. The fortieth volume was published after the death of the author, in 1739. Since that period three others have been added; but in these there are many articles of which Niceron was not the author. To a work of this kind many objections may be made, according to the particular taste or views of each individual objector; and, in fact, the French critics have expatiated with much severity upon the mistakes unavoidable in an undertaking of such magnitude and difficulty. But it is much more easy to censure than to execute. Since the time of Niceron the French have produced no such collection as his, which, with all its faults, has been the foundation, as far as it goes, of all the subsequent accounts given of the same authors. (A.)

NICETAS, David, a Greek historian, a native, as some relate, of Paphlagonia, who lived about the end of the ninth century. He wrote the Life of St Ignatius, patriarch of Constantinople, which was translated into Latin by Frederic Mutius, bishop of Termoli; and he also composed several panegyrics in honour of the apostles and other saints, which are inserted in the last continuation of the *Bibliotheca Patrum* by Combesis.

Nicetas, *Achominates*, a Greek historian of the thirteenth century, called also *Choniates*, from having been born at Chone, or Colossus, in Phrygia. He was employed in several considerable affairs at the court of Constantinople; and when that city was taken by the French in 1204, he withdrew, with a young French captive, whom he afterwards married at Nice, in Bithynia, where he ended his days in 1206. He wrote a History, or Annals, from the death of Alexius Comnenus in the year 1118, to that of Badouin in 1205; a work of which we have a Latin translation by Jerome Wolf, printed at Basil in 1557, and inserted in the body of the Byzantine Historians, printed at the Louvre.

NICHOLS, Frank, doctor of physic, was born in London in the year 1699. His father was a barrister at law, and both his parents were of good families in Cornwall. After receiving the first rudiments of his education at a private school in the country, where his docility and sweetness of temper endeared him equally to his master and his schoolfellows, Frank was in a few years removed to Westminster, and from thence to Oxford, where he was admitted a commoner of Exeter College, under the tuition of Mr John Haviland, on the 4th of March 1714. There he applied himself diligently to all the usual academical studies, but particularly to natural philosophy and polite literature, of which the fruits were most conspicuous in his subsequent lectures on physiology. After reading a few books on anatomy, in order to perfect himself in the nomenclature of the animal parts then adopted, he engaged in dissections, and then devoted himself to the study of nature, perfectly free and unbiassed by the opinions of others.

Nichols.

When he was chosen reader of anatomy in that university, he employed his utmost attention to elevate and illustrate a science which had there been long depressed and neglected; and by quitting the beaten track of former lecturers, and minutely investigating the texture of every viscus, as well as the nature and order of every vessel, he gained a high and just reputation. He did not then reside at Oxford; but when he had finished his lectures, he used to repair to London, the place of his abode, where he had determined to settle. He had once an intention of establishing himself in Cornwall, and for a short time practised there with great reputation; but being soon tired of the fatigues attendant on that profession in the country, he returned to London, bringing back with him a great insight, acquired by diligent observation, into the nature of the miliary fever, and which was attended with the most salutary effects in his subsequent practice in the metropolis.

About this time he resolved to visit the Continent, partly with the view of acquiring a knowledge of men, manners, and languages, but chiefly to make himself acquainted with the opinions of foreign naturalists on his favourite study. At Paris, by conversing freely with the learned, he soon recommended himself to their notice and esteem. Winslow's was the only good system of physiology at that time known in France, and Morgagni's and Santorini's in Italy. On his return to England, he repeated his physiological lectures in London, which were much frequented, not only by students from both the universities, but also by many surgeons, apothecaries, and others. Soon afterwards, his new and successful treatment of the miliary fever, then very prevalent in the southern parts of England, added much to his reputation. In 1725, at a meeting of the Royal Society, he gave his opinion on the nature of aneurisms, in which he dissented from that expressed by Dr Freind in his History of Physic.

In the beginning of the year 1728, he was chosen a fellow of the Royal Society, to which he afterwards communicated the description of an uncommon disorder, namely, a polypus, resembling a branch of the pulmonary vein, for which Tulpius has strangely mistaken it, coughed up by an asthmatic person. He also made observations on a treatise, by M. Helvetius of Paris, concerning the lungs. Towards the end of the year 1729, he took the degree of doctor of physic at Oxford. On his return to London, he underwent an examination by the president and censors of the College of Physicians, previously to his being admitted a candidate, which every practitioner must be a year before he can apply to be chosen a fellow. Dr Nichols was admitted into the college on the 26th of June 1732; and two years afterwards, being chosen Gulstonian reader of Pathology, he made the structure of the heart and the circulation of the blood the subject of his lectures. In 1736, at the request of the president, he again read the Gulstonian lecture, taking for his subject those parts of the human body which serve for the secretion and discharge of the urine, with the causes, symptoms, and cure of the diseases occasioned by the stone. In 1739, he delivered the anniversary Harveian oration. In 1743, he married Elizabeth, youngest daughter of the celebrated Dr Mead, by whom he had five children, two of whom died young. In 1748, Dr Nichols undertook the office of surgical lecturer, beginning with a learned and elegant dissertation on the *Anima Medica*. About this time, on the death of Dr John Cuningham, one of the elects of the college, Dr Abraham Hall was, without any apparent reason, chosen to succeed him in preference to Dr Nichols, who was his senior. With a just resentment, he immediately resigned the office of surgical lecturer, and never after attended the meetings of the fellows, excepting when business of the utmost importance was in agitation. In 1751, he took some revenge in an anonymous pamphlet, entitled The Petition of the Unborn Babes to the Censors of the Royal College of Physicians of London, in which Dr Nesbit (*Pocus*), Dr Maule (*Maulus*), Dr Barrowby (*Barebone*) principally, and Sir William Browne, Sir Edward Hulse, and the Scotch incidentally, are the objects of his satire.

Nichols burg || Nicias.

In 1753, on the death of Sir Hans Sloane in his ninety-fourth year, Dr Nichols was appointed to succeed him as one of the king's physicians, and held that office till the death of his royal master in 1760, when this skilful physician was superseded with something like the offer of a pension, which he rejected with disdain. The causes of the uncommon disorder of which George II. died, viz. a rupture of the right ventricle of the heart, he explained in a letter to the Earl of Macclesfield, president of the Royal Society, which was published in the Philosophical Transactions.

In 1772, Dr Nichols published a second edition of his treatise *De Anima Medica*, to which he added a dissertation *De motu Cordis et Sanguinis in homine nato et non nato*, inscribed to his learned friend and coadjutor Dr Lawrence.

Being at length tired of London, and also desirous of superintending the education of his son, he removed to Oxford, where he had most agreeably spent some years in his youth. But when the study of the law recalled Mr Nichols to London, he took a house at Epsom, where he passed the remainder of his life in literary retirement, not inattentive to natural philosophy, especially the cultivation of grain and the improvement of barren soils, and contemplating also with admiration the internal nature of plants, as taught by Linnæus.

His constitution never was robust. In his youth, at Oxford, he was with difficulty recovered from a dangerous fever by the skill of Drs Frampton and Frewen; and afterwards at London he had frequently been afflicted with a catarrh, and an inveterate asthmatic cough, which, returning with great violence at the beginning of the year 1778, deprived the world of this valuable man, on the 7th of January, in the eightieth year of his age.

NICHOLSBURG, a city in the circle of Brunn, in the Austrian province of Moravia. It is the municipal city of a majorat belonging to Prince Dietrichstein, which comprehends four market-towns and eight villages. There is a most magnificent palace, in a most picturesque situation, belonging to the noble proprietor, in which is a library containing 20,000 volumes. There are a minster and several other churches, with 760 houses and 7420 inhabitants, who carry on some extensive woollen and cotton manufactures, and much internal trade towards Vienna. Near to it are vineyards, yielding good wine. Long. 16. 31. 25. E. Lat. 48. 47. N.

NICIAS, an Athenian statesman, was son of Niceratus, a person of great wealth, but who seems to have taken no part in the political transactions of his country. Nicias was possessed of considerable abilities, both political and military; but he was by no means fitted to occupy the commanding position which Pericles had long filled. Yet on the death of that great man, 428 B. C., in the third year of the Peloponnesian war, Nicias was put forward by the aristocracy and the more moderate of the democratical party, as the fittest person to lead the councils of the commonwealth. He was also rather a favourite with the people, as he was liberal of his wealth for their gratification, and ever ready to assist the distressed. He was cautious, too, in all his proceedings, and avoided any thing which might excite the envy of the Athenians. He had taken no prominent part in public affairs till the death of Pericles, when the necessity of some counterpoise to the mad projects of the demagogue Cleon placed him at the head of a strong party. It shows the complete absence of any commanding genius, that Nicias should have been thought of, as his diffidence in a public assembly, and his want of firmness, stood much in the way of his usefulness. The first matter in which the two parties took opposite views was the punishment that ought to be inflicted on the inhabitants of Mitylene for their rebellion. Cleon proposed and carried a decree for putting every man to death, and for reducing the women and children to slavery. This monstrous proposition was opposed by all the influence of Nicias, but passed in spite of its evident injustice. Nicias led several expeditions, and was always successful, because, as Plutarch states, he selected those commands where success was nearly certain, although the glory might indeed be small. He took the islet called Minoa, at the mouth of the harbour of Nisæa, the seaport of Megara; and he plundered the coast of Bœotia. He commanded the fleet, 425 B. C., at the time that the island Sphacteria was blockaded by the Athenians, and willingly gave up the command to Cleon, who exclaimed that if he were in that station he would engage to subdue the island within twenty days, and bring the garrison prisoners to Athens. To the great surprise of all parties, Cleon succeeded in the enterprise (Thucydides, iv. 28). The following year we find Nicias commanding an expedition which was directed against the island of Cythera, an important appendage of the Lacedæmonian territory, and which Nicias took without much difficulty. After the death of Cleon at Amphipolis, 422 B. C., there was a strong inclination on both sides to bring the war to a close; and as Nicias was the most active in promoting the measure, it was usually called the Niceian peace. The fundamental principle of the treaty was, that each party should restore what had been taken in war, except that Nisæa was reserved to Athens, in consideration of the refusal of the Thebans to surrender Platæa. It was concluded for fifty years, 421 B. C. (Thucydides, v. 18). At this time Alcibiades began to occupy himself with public affairs, and wishing to ingratiate himself with the popular party, he took the opposite side to Nicias in almost every question. It was so in respect to the peace; and as there were some articles liable to be disputed, Alcibiades soon managed to embroil matters, and war again broke forth in all its original fury, 418 B. C. An expedition to Sicily was next proposed by Alcibiades, and although it was strongly opposed by Nicias, the decree was passed, and Nicias was appointed, along with Lamachus and Alcibiades, 415 B. C., to command the troops. Matters were conducted with various success; but the Athenians were at length completely defeated, and Nicias fell into the hands of the Syracusans. The mob demanded his life, and although Gylippus the Syracusan general exerted himself to save Nicias, it was without success. When Nicias and his colleague Demosthenes heard the sentence which had been passed against them, they anticipated their fate by putting themselves to death, in the year 413 B. C. (Thucydides, vii.; Plutarch, *Life of Nicias*; Diodorus Siculus.)

NICIAS, a celebrated painter of Athens, who flourished about 322 years before the Christian era. He was universally extolled for the great variety and noble choice of his subjects, the force and relief of his figures, his skill in the distribution of lights and shades, and his dexterity in representing all kinds of four-footed animals, a branch of the art in which he excelled all the masters of his time. His most celebrated piece was that of Tartarus, or Hell, as it is described by Homer. For this picture Ptolemy the son of Lagus offered him sixty talents, or L.11,250, which he refused, and generously presented it to his own country. He was also much esteemed by all his contemporaries for his excellent talent in sculpture.

NICOBAR ISLANDS, a group of islands situated in the Bay of Bengal, between the sixth and tenth degrees of north latitude, and between the ninety-third and ninety-fifth degrees of east longitude. They occupy the space from the north-west point of Sumatra to the most southerly of the Andaman Islands. There are seven large and twelve small islands. The principal ones are Carnicobar, Teressa, Chowry, Bombocha, Kaichull, Carmorta, Nancowry, Toulongar, Sambelong, and Nicobar or Great Sambelong; besides a multitude of smaller islands without any distinct appellation. These islands are mostly hilly, and some of the mountains in them rise to a considerable height; but others, again, are flat, and covered with cocoa-nut trees. On the other islands also a large proportion of cocoa and areca palms, with timber trees of various kinds, some of them of an enormous size, and very fit for naval purposes, are produced; and so thickly are they interwoven in some places, that they are impervious to the beams of the sun. The falling of the leaves, twigs, and fruit below, with the heavy dews, renders the island extremely unhealthy, especially to Europeans. The best island for supplies is Carnicobar; and perhaps the worst is the large one, or Great Nicobar, to the north of which runs St George's Channel; a very dangerous passage for ships, on account of the strength of the tide, and the rocks.

The wild beasts common in the Indian continent are not to be found here, such as leopards, tigers, &c. Large flocks of sheep and other cattle, originally brought hither by the Danes, and which have since run wild in the woods, are found in some of the islands; dogs and swine are also common in most of them, and being fed on cocoa-nuts, the quality of the pork is excellent. In some of the southernmost islands monkeys are found. Snakes also abound, but they are not so numerous nor so venomous as those on the coast of Coromandel. There are numerous alligators, some of them of large size, and a variety of crabs, which swarm everywhere. Shell-fish are found in such numbers, that the most beautiful collections of shells may be made here. The inhabitants appear, from their features and their figure, to belong to the Kalmuck race. They are of a copper colour, and have small eyes, small flat noses, large mouths, thick lips, and black teeth. They are well made and muscular, and are of a lively disposition, resembling the Piguans and Chinese in features, having scarcely any beard. Their mode of living is rude. They dwell in huts of an oval form, covered with cocoa-nut leaves, and supported on posts about five or six feet from the ground. These huts are always circular, resembling a stack of corn. They gain their subsistence chiefly by fishing, and trading to the neighbouring islands; whilst the women are employed in preparing the victuals, and in cultivating the ground. Vessels touching at these islands are abundantly supplied with cocoa-nuts, pine-apples, plantains, lemons, and other fruits, and also with ducks and fowls; all of which they readily exchange for cloth, tobacco, and any kind of cutlery; but they do not appear to set much value on gold and silver, such metals not being current amongst them, and tobacco being the ordinary medium of all barter and exchange. A considerable traffic is carried on amongst the islands, the chief articles of which are cloth, silver coin, iron, tobacco, and some other commodities, which they obtain from Europeans. The chief productions of these islands are the cocoa-nut and areca-nut trees. Wild cinnamon and sassafras also grow in them; and there is, besides, a nutritive fruit resembling in some respects the jaca fruit of Bengal, and growing on a species of palm which is found in abundance in the woods. The country is divided into villages, consisting of ten or twelve huts, each of which has a captain, who carries on a bartering trade with the ships that arrive, but who has no peculiar privileges. The clothing of the men is somewhat peculiar, consisting of a narrow piece of cloth about three yards long, which they wrap round their waists, and then pass between their legs, and through the girth behind, leaving the end of it to drag after them; a circumstance which

Nicodemus.

has given rise to the fabulous stories of men with tails related by Kioping, a Swedish navigator.

The religion of the natives is an absurd and unintelligible superstition, consisting of sorceries, conjurations, and other delusions practised on the ignorant multitude by the priests. Their language is remarkably poor in words; and the missionaries never having been able to acquire any considerable knowledge of it, have not succeeded in making many converts.

These islands were first settled by the Danes in 1756, for the purposes of commerce, and from that people they received the name of Frederic's Islands. But, owing to the unhealthiness of the island, almost the whole colonists died. A new attempt was made in 1768, in conjunction with the Baptist missionaries; but in 1771 only two Europeans and four Malabar servants survived. The missionaries still persevered in their attempts to effect a settlement on the islands, and received supplies from Tranquebar, both of provisions and of recruits. But the mortality continued unabated; and no progress having been made in the conversion of the natives, the attempt was finally abandoned in the year 1787. The missionaries mostly died of fevers and obstructions of the liver.

NICODEMUS, a disciple of Jesus Christ, one who was a Jew by nation, and by sect a Pharisee. The Scripture calls him a ruler of the Jews, and our Saviour gives him the name of a master of Israel. When our Saviour began to manifest himself by his miracles at Jerusalem, at the first passover which he celebrated there after his baptism, Nicodemus made no doubt but that he was the Messiah, and came to him by night, that he might learn of him the way of salvation. Jesus told him, that no one could see the kingdom of heaven except he should be born again. Nicodemus, taking this in the literal acceptation, asked, "How can a man be born when he is old? Can he enter the second time into his mother's womb and be born?" To this Jesus replied, "Except a man be born of water and of the Spirit, he cannot enter into the kingdom of God. That which is born of the flesh is flesh, and that which is born of the Spirit is spirit." Nicodemus asked him, "How can these things be?" Jesus answered, "Art thou a master of Israel, and knowest not these things? We speak that we do know, and testify that we have seen, and ye receive not our witness. If I have told you earthly things, and ye believe not, how shall ye believe if I tell you of heavenly things? No one hath ascended up to heaven but he that came down from heaven, even the Son of man, who is in heaven. And as Moses lifted up the serpent in the wilderness, even so must the Son of man be lifted up. For God so loved the world, that he gave his only begotten Son, that whosoever believeth on him should not perish, but have everlasting life."

After this conversation Nicodemus became a disciple of Jesus Christ, and there is little doubt that he went to hear him as often as our Saviour visited Jerusalem. It happened, however, that the priests and Pharisees had sent officers to seize our Lord; but they, returning to their employers, reported, that never man spoke as he did. To this the Pharisees replied, "Are you also deceived? Have any of the rulers or of the Pharisees believed on him?" Upon this Nicodemus thought himself obliged to make answer, saying, "Doth our law judge any man before it hear him, and know what he doeth?" To this they replied, "Art thou also of Galilee? Search and look; for out of Galilee ariseth no prophet. After this the council was dismissed. At last Nicodemus declared himself openly to be a disciple of Jesus Christ, and he came along with Joseph of Arimathea to pay the last duties to the body of Christ, which they took down from the cross, embalmed, and laid in a sepulchre.

We are told that Nicodemus received baptism from the disciples of Christ; but it is not mentioned whether this was before or after the passion of our Lord. It is added, that the Jews being informed of the circumstance, deposed him from his dignity of senator, excommunicated him, and drove him from Jerusalem; but that Gamaliel, who was his cousin-german, took him to his country-house, and maintained him there till his death, when he was honourably interred near St Stephen. There is still extant an apocryphal gospel under the name of Nicodemus, which in some manuscripts bears the title of the Acts of Pilate.

Nicodemus || Nicolas.

NICOLAIEV, or Nicolaief, a city of Russia, in the province of Cherson. It stands on the river Bug, at about eight leagues from the entrance of that river into the Black Sea, and at the point where the river Ingoul falls into it. From the entrance of the Bug at Oczakow, up to this city, its depth in the mid-channel is from four to six fathoms, and the navigation is consequently safe for the largest ships. This place is one of the chief naval arsenals on the Black Sea, and, besides ships of war, many gun-boats, with sails and oars fit for navigation, are built and equipped. The timber for ship-building comes chiefly by the Dnieper to Cherson. The admiral commanding in chief in the Black Sea, and a number of inferior officers, have their permanent residence at this place. The town is much scattered; its streets are wide and regular, and many of them are planted with trees on both sides, but scarcely any of them are paved. Almost all the houses are built of stone, and separated from each other by trees and gardens; but scarcely any of them are of a large size, and few have any pretensions to magnificence. The climate is healthy, the air is pure, rents are moderate, provisions are cheap, and the society is good; but fuel is scarce, and water is conveyed from a very copious fountain near the gates of the city. The principal public buildings are a new church in the great square, the guild-hall, the admiralty, the docks, the custom-house, the marine barracks, and the hospital. There is a school for naval instruction and for the education of the artillery, and a fine astronomical observatory. The number of inhabitants is now about 15,000, the greater part of whom are connected with the marine service. The observatory is situated in longitude 32. 0. 15. E. and latitude 46. 59. N.

NICOLAITANS, in ecclesiastical history, Christian heretics, who assumed this name from Nicholas of Antioch, who, being a Gentile by birth, first embraced Judaism, and then Christianity, when his zeal and devotion recommended him to the church of Jerusalem, by whom he was chosen one of the first deacons. Many of the primitive writers believe that Nicholas was rather the occasion than the author of the infamous practices of those who assumed his name, and who were expressly condemned by the Spirit of God himself (Rev. ii. 6). Their opinions and actions were indeed highly extravagant and criminal. They allowed a community of wives, and made no distinction between ordinary meats and those offered to idols. According to Eusebius, they subsisted but for a short time; yet Tertullian says that they only changed their name, and that their heresies passed into the sect of the Cainites.

NICOLAS, St, a large market-town of the Netherlands, situated in the province of East Flanders, and arrondissement of the Dender. It is well built, has a fine market-place, and is in one of the richest agricultural districts of that rich country, where husbandry is better conducted than in almost any part of Europe. It has 11,500 inhabitants, many of whom are employed in making cloths and cotton goods, in distilleries, and in various other branches of manufacture.

Nicolas, St, an island of the Atlantic Ocean, and one of the most considerable of those of Cape Verd, being situated between St Lucia and St Jago. It is of a triangular figure, and about seventy-five miles in length. Long. 33. 35. W. Lat. 17. 0. N.

Nicole.

NICOLE, PETER, a celebrated French moralist and theologian, the nephew of Claude Nicole, a French poet, and one of the most illustrious writers of the Port-Royal, was born at Chartres in October 1625. His father, John Nicole, having a perfect knowledge of the ancient languages, instructed him in the elements of grammar, and initiated him so thoroughly in the classics, that at the age of fourteen he had completed his preliminary studies, and read the best works in Greek and in Latin. He then proceeded to Paris, where he commenced a course of philosophy and theology, and at the same time applied to the study of Hebrew; but the weakness of his sight, occasioned by excessive application, obliged him to abandon this pursuit, in which he had already made great progress. Having completed his course of theology, and received the degree of bachelor, he was preparing to take his license, when the troubles which broke out in the university, on the subject of the famous propositions of Jansenius, forced him to defer the accomplishment of this object. Being attached by gratitude and esteem to the inmates of the Port-Royal, he passed several years in that house, occupied in teaching the belles-lettres. But, in 1655, he returned to Paris to labour under the direction of Dr Arnauld, with whom he was united by the ties of the most intimate friendship; and, desiring to live altogether unknown amidst the bustle of the capital, he took the name of Rosny. The advancement of Jansenism appears to have furnished the motive that induced him to undertake a journey which he made into Germany, in the course of the year 1658; and whilst there, he not only translated into Latin the *Lettres Provinciales*, in the composition of which he had participated, but published them, accompanied with very virulent notes. He soon returned, however, to join Arnauld; and they retired together to Châtillon, where they applied themselves to the preparation of different writings. Nicole, although he did not entirely adopt the opinions of the Jansenists, made frequent excursions to Port-Royal, Paris, and the neighbouring provinces, in the interest of that party; but in these he acted with extreme circumspection, not choosing, as he himself observed, to play any part in civil wars. Being warmly solicited by his friends to enter into holy orders, he at length resolved to demand ordination of the Bishop of Chartres, in whose diocese he resided. But that prelate refused to ordain him, no doubt by reason of his connections with the Port-Royal. He continued undisturbed at Paris until the year 1677, when a *Lettre*, which he wrote in the names of the Bishops of St Pons and Arras, on the laxity of the casuists, raised such a storm against him, that he was obliged to withdraw from the capital. For some time he remained concealed in the environs of Chartres and of Beauvais; but the death of the Duchess of Longueville, the most ardent protectress of Jansenism, having decided him to quit France, where he did not consider himself as any longer safe, he left the kingdom, and took refuge successively at Brussels, the Abbey of Orval, and Liège, frequently changing his name and the place of his retreat, and believing himself incessantly exposed to the machinations of his enemies. At length, by the intercession of M. de Harlay, the archbishop of Paris, he obtained permission to return secretly to Chartres, and soon afterwards to fix his residence at Paris, where he resumed his ordinary occupations; and it was then that he completed his *Essais de Morale*, a work which is less read than esteemed, and which stamped his reputation as a writer. In the last years of his life he mingled in the dispute about Quietism, and took the part of Bossuet against Fénélon, but with wisdom and moderation. Having for some time been deprived of the use of his hands, he was meditating alone in his cabinet when he was suddenly struck with apoplexy. The tidings soon spread in the capital, and the crowd of persons who hurried to visit the pious cenobite proved the high consideration which he enjoyed. Racine, being reconciled to his master, came in a diligence, bringing a medicine (*gouttes d'Angleterre*) which for a moment revived him; but the resuscitation was soon succeeded by a relapse, and he died two days afterwards, on the 16th of November 1695, at the age of seventy. He had given orders that he should be interred without any ceremony; but his will, in this particular, was not respected, and his remains were accompanied to the grave by the most distinguished men of the time.

Nicole, being of a simple and ingenuous character, evinced during his whole life the timidity of an infant. Nothing was more easy than to embarrass him in discussion; an objection which he had not foreseen entirely disconcerted him. Speaking of Tréville, one of his friends, he said, "Tréville beats me in the chamber; but before he reaches the foot of the stair I confute him." In the last year of his life he seldom went abroad, being afraid that, in passing along the streets, a tile would fall upon his head. He had also a great dread of travelling, and particularly of aquatic excursions. During a long period he had relegated himself to the faubourg Saint-Marcel; and when asked the reason of this, he replied, "It is because the enemies who menace Paris will probably enter by the gate of Saint Martin, and consequently will be obliged to traverse the whole city before reaching the place where I live." But, with all this simplicity and timidity, Nicole had a reach and an accuracy of thought which were altogether admirable. He equalled the best dialecticians, in the order, the method, the sequence, and the depth of his ideas; but as his object in all his works was rather to prove than to please, his style, although remarkable for its purity and clearness, often fatigues by its dryness and monotony. "On quitte ses *Essais* sans peine," says Palissot; "on y revient sans plaisir, parce que les lecteurs ont besoin d'être flattés." Nicole attempted panegyric, but soon found that he had no talent for a species of composition which requires invention and warmth of style.

A list of the works of Nicole will be found in the *Mémoires* of Niceron (tome xxix.), at the end of his Life by the Abbé Goujet, and also in the Dictionary of Moreri. The following are the principal, viz. 1. Epigrammatum Delectus ex omnibus tum veteribus tum recentioribus Poëtis, cum Dissertatione de vera Pulchritudine, Paris, 1659, in 12mo; 2. La Perpétuité de la Foi de l'Eglise Catholique, touchant l'Eucharistie, Paris, 1664, in 12mo, called *la Petite Perpétuité*, to distinguish it from the great work which bears the same title; 3. Traité de la Foi Humaine, Paris, 1664, in 4to, a work in which Arnauld had some share; 4. Les Imaginaires et les Visionaires, ou Lettres sur l'Hérésie Imaginaire, Liège, 1667, in two vols. 12mo; 5. La Perpétuité de la Foi de l'Eglise Catholique, touchant l'Eucharistie, Paris, 1669–1676, in three vols. 4to, a masterpiece of reasoning, which appeared under the name of his friend Arnauld; 6. Essais de Morale, et Instructions Théologiques, Paris, 1671–1672, in twenty-five vols. 12mo; 7. De l'Unité de l'Eglise, ou Réfutation du Nouveau Système de Jurieu, Paris, 1687, in 12mo. The last writings of Nicole turn upon the system of general grace, which he supported, to the no small displeasure of most of his friends. The consequence was a controversy, which appears to have produced some coldness on both sides. Arnauld, in his Letters (tome vii.), expresses himself with much force on the subject; and Quesnel complained warmly to Nicole of this species of defection on his part. The various pieces produced in this dispute will be found in a collection of writings on general grace, published by Fouillon in 1715, with a long preface; and a curious analysis of the *Traité de la Grace Générale* will be found in the *Bibliothèque* of the Dictionary of Richelet.

Nicole had a large share in the *Méthodes Grecques et Latines*, and also in the excellent treatise on Logic, known under the name of the Port-Royal. The life of this able and laborious writer has been written by the Abbé Goujet, who is, however, more of a panegyrist than a biographer; by Besoigne, in his *Histoire de Port-Royal* (tome iv.); and also by Saverien, in his *Vies des Philosophes Modernes* (tome i.). (A.)

NICOMEDES, the name of several kings of the ancient Bithynia. See the article BITHYNIA.

NICOMEDIA, the metropolis of Bithynia, which was built by Nicomedes, the grandfather of Prusias. Nicomedia was famous, not only under its own kings, but also under the Romans; it was the royal residence of Diocletian, and also, if we may credit Nicephorus, that of Constantine whilst Constantinople was building. It is situated at the bottom of a bay of the Propontis, in Asia Minor, and still bears the ancient name. Long. 30. 0. E. Lat. 41. 20. N.

NICOMEDUS, a geometrician, celebrated on account of the invention of the curve called conchoid, which is equally useful in resolving the two famous problems of doubling the cube and trisecting the angle. It appears that he lived soon after Eratosthenes, for he rallied that philosopher on the mechanism of his mesolabe. Geminus, who flourished in the second century before Christ, has written on the conchoid, though Nicomedus was always esteemed the inventor of that curve. Those who place him four or five centuries after Christ must be ignorant of these facts, by which we are enabled to ascertain approximately the time at which he lived.

NICOPOLIS, a province of European Turkey, which extends in north latitude from 42. 44. to 43. 46. and in east longitude from 23. 30. to 26. 4. This district is naturally fertile; but agriculture is in a neglected state, and the chief product is cattle. The capital, of the same name, is situated on the Lower Danube. It is fortified, and connected with a strong citadel, and it is said to contain 10,000 inhabitants. It is the seat of a Catholic and also of a Greek bishop.

NICOSIA, a city of the island of Sicily, in the kingdom of Naples, and in the province of Demone, eighty miles from Palermo. It stands on the ridge of a rocky mountain, the Herbita of antiquity. It is an ill-built city, and suffers from a scarcity of water; but as the situation is more healthy than that of many of the Sicilian cities, it contains a population of 12,060 inhabitants, occupying 3167 houses, many of which are formed by excavations in the rocks. Near to it are two springs of fossil oil, a copious rock-salt mine, and several sulphureous baths.

NICOT, JOHN, seigneur of Villemain, and master of the French king's household, was born at Nismes, and sent in 1559 as ambassador to Portugal, whence he brought the plant which, from his name, was called *Nicotiana*, but is now more generally known by the name of *tobacco*. He died at Paris in the year 1603. Nicot wrote a French and Latin dictionary, in folio; a Treatise on Navigation; and some other works.

NICOTERA, a city of the province of Calabria Ulteriore, in the kingdom of Naples. It stands on the sea-coast, at the mouth of the river Mesina, is the seat of a bishop, and has a cathedral, with several other churches. It suffered by the earthquake of 1783; but has been since restored, and now contains 6250 inhabitants, who follow chiefly the fisheries, and cure large quantities of anchovies and sardinias.

NICOTIANA, or TOBACCO, a plant so called from Nicot above mentioned. There are seven species of nicotiana, of which the most remarkable is the *tabacum*, or common tobacco plant. This was first discovered in America by the Spaniards about the year 1560, and by them imported into Europe. It had been used by the inhabitants of America long before, and was called by those of the islands *yoli*, and by the inhabitants of the continent *pætun*. It was sent into Spain from Tabaco, a province of Yucatan, where it was first discovered, and from which it takes its common name. Sir Walter Raleigh, it is generally said, first introduced it into England about the year 1585, and taught his countrymen how to use it. Dr Cotton Mather, however, in his Christian Philosopher, says, that in the above year one Mr Lane brought over some of it from Virginia, which was the first time it had ever been seen in Europe. Tobacco is commonly used by the oriental nations, though it is uncertain by whom it was introduced amongst them. Considerable quantities of it are cultivated in the Levant, on the coasts of Greece and the Archipelago, in Italy, and also in the island of Malta.

There are two varieties of that particular species of nicotiana which is cultivated for common use, and which are distinguished by the names of *Orinoko* and *sweet-scented tobacco*. They differ from each other only in the figure of their leaves, those of the former being somewhat longer and narrower than those of the latter. They are tall herbaceous plants, growing erect with fine foliage, and rising with a strong stem from six to nine feet in height. The stalk near the root is above an inch in diameter, and surrounded with a kind of hairy or velvet clammy substance of a yellowish-green colour. The leaves are rather of a deeper green, and grow alternately at the distance of two or three inches from each other. They are oblong, of a spear-shaped oval, and simple; the largest being about twenty inches long, but decreasing in size as they ascend, till they come to be only ten inches long, and about half as broad. The face of the leaves is much corrugated, like those of spinage when fully ripe. Before they attain maturity, when they are about five or six inches in length, the leaves are generally of a full green, and rather smooth; but as they increase in size they become rougher, and acquire a yellowish cast. The stem and branches are terminated by large bunches of flowers, collected into clusters, of a delicate red, the edges, when full blown, inclining to a pale purple. They continue in succession till the end of the summer, when they are succeeded by seeds of a brown colour and a kidney shape. These are very small, each capsule containing about 1000; and the whole produce of a single plant is reckoned at about 350,000. The seeds ripen in the month of September.

The following extract, which is copied from a manuscript of Dr Barham,[1] containing directions for raising, cultivating, and curing tobacco in Jamaica, is perhaps worthy of the attention of those who wish to be further acquainted with this subject.

"Let the ground or woodland wherein you intend planting tobacco be well burned, as the greater the quantity of wood ashes the better. The spot you intend raising your plants on must be well strewed with ashes, laid smooth and light; then blow the seed from the palm of your hand gently on the bed, and cover it over with palm or plantain leaves.

"When your plants are about four inches high, draw them and plant them out about three feet asunder; and when they become as high as your knee, cut or pluck off the top; and if there are more than twelve leaves on the plant, take off the overplus, and leave the rest entire.

[1] This gentleman was contemporary with Sir Hans Sloane. He was a man of great probity, an able physician, and a skilful naturalist. He collected and arranged a number of the plants of Jamaica, which he presented to Dr Sloane, and made several communications to the Royal Society.

"The plant should now be daily attended to, in order to destroy the caterpillars that are liable to infest it; as also to take off every sprout or sucker that puts out at the joints, in order to throw the whole vegetable nourishment into the large leaves.

"When the edges and points of the leaves begin to turn a little yellow, cut down the stalks about ten o'clock in the morning, taking the opportunity of a fine day, and be careful the dew is fully off the plant; and do not continue this work after two in the afternoon. As fast as it is cut let it be carried into your tobacco-house, which must be so close as to shut out all air (on this much depends), and hung up on lines tied across, for the purpose of drying.

"When the stalks begin to turn brownish, take them off the lines and put them in a large binn, and lay on them heavy weights for twelve days; then take them out, and strip off the leaves, and put them again into the binn, and let them be well pressed, and so as no air gains admission, for a month. Take them out; tie them in bundles about sixty leaves in each, which are called *monocoes*, and are ready for sale. But observe to let them always be kept close till you have occasion to dispose of them.

"Let your curing house be well built, and very close and warm. If a boarded building, it will not be amiss, in a wet situation, to cover the whole outside with thatch and plantain trash, to keep off the damps; for by this care you preserve the fine volatile oil in the leaves. Observe, no smoke is to be made use of, or admitted into your curing house."

In 1790, the quantity of tobacco retained for home consumption in Great Britain and Ireland was 11,860,661 pounds, and the nett amount of revenue derived from it was L.645,579. 5s. 11d. The quantity entered for home consumption in the year ending the 5th of January 1836 was 22,116,759 pounds, and the amount of duty received thereon was L.3,354,459. 1s. 5d. The quantity imported in 1834 was 39,477,907 pounds; in 1835, 25,818,965 pounds: the quantity exported in 1834 was 13,264,614 pounds; in 1835, 13,492,000 pounds: the quantity retained for consumption in 1834 was 21,193,860 pounds; in 1835, 21,945,589 pounds.

The price of tobacco in bond in the London market ranges from 3d. to 5d. per pound. The rates of duty per pound on tobacco in the year ending 5th of January 1836 was, for unmanufactured of any British possession in America, 2s. 9d.; of any other place, 3s.; for manufactured tobacco and segars, 9s.; snuff, 6s.

An Account of the Number of Pounds Weight of Leaf Tobacco, Manufactured Tobacco, Segars, and Snuff, upon which Duty was paid quarterly from the year 1835, *ending 5th of January* 1836; *also the rate of Duty, and the total amount of the same.*

Quarter ending	Quantity entered for Consumption in the United Kingdom in the several quarters of the year ended 5th January 1836.				Gross Amount of Duty received thereon.											
	Unmanufactured Tobacco.	Manufactured Tobacco, &c.	Snuff.	Total.	Unmanufactured Tobacco.			Manufactured Tobacco, &c.			Snuff.			Total.		
					L.	*s.*	*d.*	*L.*	*s.*	*d.*	*L.*	*s.*	*d.*	*L.*	*s.*	*d.*
5th April 1835.	5,660,167	34,023	40	5,694,230	848,108	9	6	15,310	9	3	12	3	7	863,431	2	4
5th July 1835..	5,284,269	34,863	34	5,319,166	790,071	7	0	15,690	3	11	10	4	7	805,771	15	6
10th Oct. 1835.	5,652,943	39,730	97	5,692,770	846,490	19	6	17,882	1	10	29	4	11	864,402	6	3
5th Jan. 1836..	5,377,543	33,027	23	5,410,593	805,983	13	0	14,863	6	4	6	18	0	820,853	17	4
	21,974,922	141,643	194	22,116,759	3,290,654	9	0	63,746	1	4	58	11	1	3,354,459	1	5

NIDDUI, in the Jewish customs, is used to signify *separated* or *excommunicated*. This, according to some, was to be understood only of the lesser sort of excommunication in use amongst the Hebrews. He who had incurred it was obliged to withdraw himself from his relations, at least to the distance of four cubits; and it commonly continued a month. If it was not removed in that time, it might be prolonged for sixty or even ninety days; but if, within that term, the excommunicated person did not give satisfaction, he fell into the *cherem*, which was a second sort of excommunication; and thence into the third sort, called *shammata* or *shematta*, the most terrible of all. But Selden has proved that there were only two kinds of excommunication, the greater and less; and that these three terms were used indifferently.

NIDEGH, a considerable town of Caramania, in Asiatic Turkey, being the ancient Cadyna. Some parts of the old walls are still standing, composed of large stones decayed with age; and the streets contain many ruined fragments of columns. It is inhabited by about 5000 Greeks and Turks, who are very poor, and is the residence of a pasha. It is twenty-two miles east of Karahissar.

NIDJIGUL, a fortress of the south of India, in the province of Mysore. It was taken in 1770 by the Mahrattas, afterwards recovered from them by Hyder, and now belongs to the rajah of Mysore. Long. 77. 16. E. Lat. 13. 15. N.

NIDIFICATION, a term generally applied to the formation of a bird's nest, and its hatching or bringing forth its young. See ORNITHOLOGY.

NIDUS, amongst naturalists, signifies a nest or proper repository for the eggs of birds, insects, &c. where the young of these animals are hatched and nursed.

NIDYCAVIL, a small village in the south of India, in North Coimbetoor, being situated in the tract between the Karnata and Chera countries. Long. 77. 42. E. Lat. 11. 51. N.

NIEBUHR, BERTHOLDT-GEORGE, son of Carsten Niebuhr the celebrated Arabian traveller, was born at Copenhagen on the 27th of April 1776. The father, on his return from his travels in the East, had married the daughter of the celebrated physician Blumenberg, and would probably have established himself in the Danish capital; but the disgrace of the minister Bernstorf, his protector, had inspired him with a great dislike for that city. Denmark, to which the traveller now belonged, desired to employ him in the corps of military engineers; in fact, the government of that country intended to avail itself of his knowledge for determining some geographical positions in Norway. Niebuhr, however, preferred a civil appointment, that of *Land-*

schrieber,[1] at Mildorf in Holstein.[2] If he had retained his taste for distant enterprise and adventure, the East was the theatre upon which alone he would have sought to indulge such a predilection; but the attachment which he had conceived for his wife, and the birth of two children, presented insuperable obstacles to the execution of any project of this kind. He therefore remained in the bosom of his family, occupied with the preparation of his travels, and intent only upon giving to his children useful lessons, enforced by a virtuous example.

The original intention of the Arabian traveller was to open to his son the route to the East. With this view the early studies of the youth were arranged; he was taught English, a language almost indispensable to the navigator, and Arabic, which he might one day have to speak in the native country of Mahommed; whilst geography and the mathematics were destined to form the basis of his education. But genius is a bough which it is vain to bend in a direction not given to it by nature. Niebuhr the father had traversed space, Niebuhr the son longed to overleap time; he saw his object distinctly marked beyond past ages, and, free from all trammels, it was towards antiquity that his meditations constantly aspired. He has himself told us, with a laudable frankness, that his father often lost patience with him on account of his desultory pursuits; yet it was during this time that he employed all his leisure in studying Sophocles. When his father chanced to give him a lesson in geography, or to pronounce the name of D'Anville, for which he entertained the most profound veneration, young Niebuhr saw before him nothing but the Gaul of Cæsar; he read again and again the commentaries of that great captain, and only derived from the learned French geographer archeological notions calculated to illustrate the progress of the Roman conqueror, or to restore some ancient city of Gaul.

Nevertheless, these exercises were merely preparatory. The celebrated philologist Jäger, editor of the Latin panegyrists, was the first master of Niebuhr; and it was under this renowned scholar that he became initiated into the mechanism of languages. His father, indeed, regarded languages only as the means of attaining science; he never stopped to examine the details; provided he understood the import, he was satisfied. The lessons of Jäger took deep root in the analytical mind of his pupil, who already began to display that vigorous stamp of genius which promises to make more discoveries in the obscure recesses of a library than the most robust traveller can hope to achieve on distant coasts, or on islands regarded as inaccessible to the navigator. Already had the idea of exposing him to the dangers of such an adventurous career been abandoned. The mother, whose solicitude was pushed to an imprudent excess, had at first created obstacles to the accomplishment of the views of Carsten Niebuhr respecting his son. In fact, the too assiduous cares which she lavished upon him so weakened his constitution that his health always continued precarious, and the irritability of his nerves sometimes re-acted upon his character, which, without ever ceasing to be noble and generous, was not always exempt from whim and caprice.

But whatever may have been the motives or considerations which changed the resolution of the father, young Niebuhr was sent to Hamburg, where he studied the science of commerce, as well in the prelections given on this subject by Professor Büsch, as in the most respectable mercantile houses of that rich city. But the illustrious Vossius was the friend of his father, and Klopstock likewise resided in Hamburg. How then could he resist the impulse of his genius, or escape being inspired with new ardour in favour of antiquity? When Vossius spoke of the Greeks and Romans, it might have been supposed that he had just quitted their society. Niebuhr was certainly no poet; but his genius felt itself warmed by the conversation of these great men. To Vossius he was indebted for those views, so distinct and precise, which he afterwards developed respecting the people of antiquity; whilst Klopstock taught him to interpret the language of tradition, when it speaks in its own natural voice, and describes, with equal grandeur and simplicity, the Ruminal fig-tree, the augury of the birds of destiny, the birth of Servius, or the truly Homeric battle of the Lake Regillus. "On dirait," says M. de Golbéry, "que dans ces pages admirables son style, tantôt naïf et tantôt majesteux, veut ranimer l'esprit du lecteur, et la dédommager de la sécheresse inséparable de la dissertation, comme les accens d'une musique religieuse délassent, par intervalles, une âme fatiguée de trop longues méditations."

But, not to anticipate, Niebuhr, having entered the university of Kiel, applied himself zealously to the study of jurisprudence, and was distinguished by the philosopher Jacobi, whom he ever afterwards esteemed, and also by Hentzler the physician, whose grand-daughter he subsequently married. From Kiel the young student proceeded to Edinburgh. The object of his father in prescribing this voyage was to combine with his other studies that of the natural sciences. Nor were his views in this particular disappointed. Niebuhr distinguished himself especially in chemistry, and became so enamoured of his experiments that little was wanting to direct his attention definitively to that subject, and fix his views on discovering some new substances rather than on re-awakening old and forgotten notions. Throughout the whole of his after life he delighted to recall his residence in Edinburgh. An old ship-captain of the Jacobite family of the Scotts had thirty years before received on board his vessel Niebuhr the traveller, and still prided himself on the circumstance. The honest seaman received the son of his old friend with affectionate cordiality, and the young German student lived in the greatest intimacy with the members of his family, "à laquelle," says M. de Golbéry, "appartient le célèbre romancier."

The studies of Niebuhr were now completed. A residence of eighteen months in Scotland had enabled him to study the institutions of that country; but as he wished to become still more intimately acquainted with the nation which his father estimated so highly, he devoted six months to travelling through different parts of Great Britain. During this period he took the greatest pains to inform himself respecting the manners, the usages, and the customs of the people, and in particular directed his atten-

[1] Secretary of justice or registrar would be an incomplete translation of this word. The *Landschrieber* also exercised administrative and financial functions. That the place of Niebuhr the father was superior to that of a simple registrar, is evinced by the circumstance that he joined to it the title of counsellor of state.

[2] "Au bord de l'Océan Septentrional," says M. de Golbéry, "non loin de l'embouchure de l'Elbe, est une contrée qui, sous le nom de Hadeln, a fait partie de la ligue Frisonne, et qui renferme la paroisse de Ludingworth, composée de cultivateurs libres. Le duché de Saxe-Lauenbourg, le Hanovre, la France, ont successivement étendu leurs limites jusqu'à ces rivages, mais peu de personnes connaissent ce petit pays. Désormais il sera célèbre, car il a donné à la science un nom deux fois illustré. Niebuhr le père a su conquérir pour la géographie l'Arabie, l'Inde, la Mer Rouge, régions dont les longitudes n'étaient pas déterminées, dont les cartes étaient imparfaites; Niebuhr le fils a fait reluire des clartés de son génie les antiques débris des institutions de Rome, et d'un regard assuré il a reconnu, malgré l'obscurité des siècles, la source du grand peuple, et les affluens qui lui ont apporté le tribut de leurs générations." (*Notice Historique sur la Vie et les Ouvrages de* B. G. NIEBUHR, *conseiller d'état, membre de l'Académie des Sciences de Berlin.*)

tion to the system of British legislation; nor do we know any instance of a foreigner who, in the same space of time, acquired so extensive a knowledge of the public law and policy of this country. Niebuhr, in fact, loved that inertia, amounting even to obstinacy, which resists amelioration, and which sacrifices progressive improvement to the desire of repose. This sentiment was with him pushed to excess, and hence he felt distrustful of every ministry which appeared to favour reform. In a word, he had imbibed the essential spirit of Toryism, the distinctive characteristic of which is resistance to change. Dazzled by the greatness which this country had attained, he hastily concluded that all was directly owing to its peculiar institutions; and thinking that these were as perfect as human wisdom could render them, he conceived that nothing remained but to place them beyond the reach of innovation.

Niebuhr commenced his administrative career at Copenhagen, where he was at first appointed secretary to Schimmelmann, the minister of finance; and about the same time we also find him acting as secretary to a commission instructed to arrange some affairs with the Barbary powers. At the period of the bombardment of the Danish capital by the English, the precautions taken by Niebuhr contributed materially to save from the common disaster the library of which he had for some time been assistant-keeper. The knowledge which he had acquired in matters of finance soon became of practical utility to its possessor, and he was appointed one of the directors of the Danish bank. Distinguished alike for his ability and his desire to do good, Niebuhr did not confine his labours to the cabinet, but published several memoirs on the public administration, and on political economy. In the year 1804 he married the daughter of the *landvoght* of the district of Heydt. This union proved happy, and opened to him the prospect of enjoying in the bosom of his family the repose necessary for enabling him to discharge with credit his administrative labours. A career at once honourable and affluent seemed calculated to satisfy his ambition, whilst it afforded him leisure for the study of letters; it appeared, indeed, that Germany must for ever abandon to Denmark both Niebuhr the traveller and Niebuhr the future historian of Rome; and to the brilliant position which the latter owed to his father's celebrity and his own merit, it might have been supposed that he would content himself with adding the honourable reputation which, in official situations, always follows talent and probity. But fortune had ordered it otherwise.

The French were now waiting upon the shores of the Channel until winds less contrary should fill their sails, and waft them across to the white cliffs of Albion; their ensigns, it was hoped, were destined to wave over another Hastings, and, by a new conquest, to efface the remembrance of the warlike Normans. But England, alarmed at the prospect of a struggle for existence on her own soil, called Austria to her aid. France, however, was not taken unprepared. The legions arrayed for the invasion of England rushed like a torrent into the heart of Germany; in three months the Austrian monarchy was humbled in the dust; and the Russians, then so much dreaded, were driven into the lakes of Moravia. If less prejudiced, Niebuhr would perhaps have admired the prodigies performed by the modern Romans; and these few months, which concentrated more glory than might have sufficed to illustrate an age, would have appeared to him a fragment of the annals of a great people. But early impressions are almost never effaced. From his infancy, he had, in the paternal mansion, imbibed the most bitter prejudices against France. On the one hand, he had been accustomed to hear only of the degenerate men or the effeminate courtiers of the old monarchy; and on the other, he had been horrified with pictures of the revolutionists, their scaffolds, and their crimes. In vain did the French army throw its victorious sword into the balance. The father of Niebuhr remained unmoved by its achievements, or rather became more exasperated in consequence of its successes; for if Denmark was the country of his adoption, he was a Hanoverian by birth, and each battle gained by the French afflicted the ancient subject of England, and wounded the sentiment of German independence. Even the expedition to Egypt, with all its romantic incidents and exploits, found no favour in the eyes of the old traveller. That the French neither could nor would do good, was with him a settled maxim.[1]

It is not to be wondered, then, if his son remained insensible to the astonishing achievements of Napoleon. His soul, it is true, was formed to be moved with all noble and generous sentiments, to admire all courageous and heroic actions; but in the warriors of France he saw only the slaves of a military despot, and the instruments employed by him to overwhelm Germany. The fidelity of Denmark to France was, according to him, nothing but a base and cowardly compliance. That state, he conceived, was sacrificing its interests to its predilections; and when Prussia imagined that she had merely evoked the shade of the Great Frederick, in order to find nothing but Soubises in the armies of France, Niebuhr associated himself with this fatal delusion, and was one of the first writers to raise the cry of war. However, as the servant of a friendly power, he did not venture upon a direct attack. He borrowed the thunder of Demosthenes, translated the first Philippic, added to it notes filled with allusions to actual circumstances, and, lastly, dedicated the work, the first fruit of his classical acquisitions, to the Emperor Alexander. But he forgot that Napoleon was not Philip king of Macedonia, nor his warriors the barbarous oppressors of Athens; and he also neglected to observe that civilization was not likely to come to us from the north in virtue of an imperial ukaz. Prussia, however, understood this language; she called Niebuhr to her service, and he was named director of the commerce of the Baltic. But he did not long enjoy his new dignity. Scarcely had he arrived at Berlin, when the storm which burst at Iena and Auerstadt reduced the Prussian monarchy to dust; it became necessary to fly, and abandon to the homage of the conqueror the remains of the great Frederick. From Königsberg to Memel, from Memel to Riga, the court skulked from asylum to asylum. The French cannon pursued it everywhere, and amidst the snows and mud of Eylau, as well as on the plains of Friedland, the imperial eagles rushed to victory.

Nevertheless, Prince Hardenberg invited Niebuhr to assist in all the councils which were held during this crisis. The rectitude and constancy of his character never yielded or flinched; the same love of country, the same aversion for foreign domination, always distinguished him. During his stay at Riga, he employed what leisure business allowed him in studying the literature of Russia; but it appeared to him poor and barren, nor do we find that his occupations in this way had much influence upon his future labours. It may be supposed, however, that these pursuits inspired him with a predilection for the Russians, and an aversion for Poland, which it is difficult to reconcile with the generosity of his character. After the conferences of Tilsitt, he returned to Berlin; and recent

[1] It would be unjust not to add, however, that Carsten Niebuhr afterwards saw reason to modify his prejudices, in as far at least as concerns the sciences.

Niebuhr.

events having made him advantageously known, he was employed on a mission of high importance, namely, to negotiate with the agents of Great Britain in Holland some affairs of finance. The latter country was then governed by King Louis, or rather it was administrated in spite of him, and in the interest of his brother. If this prince had been master of his states, tradition would preserve, for generations to come, the memory of one good king more. He understood perfectly all that was necessary to insure the prosperity of his new subjects; he was enlightened, loyal, and generous. Of this it was not long ere Niebuhr obtained a satisfactory proof. The police of the empire had covered the kingdom of Holland with its agents, and he had become an object of their attention. The king hastened to apprise him of the dangers to which he was exposed, and even to assist him in effecting his escape. The day came when this good king found himself proscribed and persecuted, even in the capital of the Christian world; all the thrones raised by his brother had been overthrown; but the noble use which he had made of his power lived in the recollection of the ambassador of Prussia, for that ambassador was Niebuhr; and Louis was respected at Rome for having been beneficent at the Hague.

When Niebuhr returned to his own country, the hour of her deliverance had not yet come. Prussia was then endeavouring to console herself for her misfortunes by a wise and liberal administration, and the ministry of Berlin was occupied in founding useful establishments. Niebuhr, who had just been named counsellor of state, had profoundly studied the agrarian law of the Romans; and Prussia at this period followed a system of improvement and colonization of waste lands, on which he furnished to the government some very remarkable memoirs. Roman history was thus in some measure applied to the soil, whilst the utility of the exact sciences, the progress of which exercises an influence on agriculture and the arts, was at the same time exemplified. In every point Niebuhr powerfully seconded the able and generous views of M. de Stein.

About the same period, Berlin was distinguished for a scientific activity almost without example. The university was created, and the Academy of Sciences re-organized. The recent labours of Niebuhr had secured him a place amongst the most eminent men of the kingdom; he belonged to the university, and was likewise a member of the academy. Buttmann, Heindorf, Spalding, and Savigny, arrived in succession. With these celebrated men he lived in terms of the greatest intimacy. In him also they recognised their equal, and, penetrating the depth of his views, notwithstanding the distrust which he felt of his own powers, they conducted him to that chair of Roman history, which he hesitated to occupy; "comme s'il pressentait qu'après en avoir franchi les degrés, il ne lui serait plus donné de s'arrêter; comme s'il était effrayé de la rapidité avec laquelle ils l'élèveraient jusqu'à l'immortalité."

The eulogium contained in these words of Golbéry may be thought exaggerated; but in reality it is not so. Those who see nothing in history but a sequence of annals, and of facts crowded on facts, are pre-occupied with the thought that contemporary authors have bequeathed to us all antiquity, and cannot conceive that the moderns should employ themselves otherwise than in compiling and arranging ancient texts. It appears to such persons that to restore the beautiful edifice raised by Titus Livius, we must take fragments from Dionysius of Halicarnassus, Sallust, and Polybius; or glean here and there, in the grammarians and rhetoricians, some scattered indications which the current of ages would have swept into oblivion, if they had not scattered their erudition athwart its course. To act in this way is no doubt useful. By doing so one may acquire the reputation of Trenshomius, make supplements to Titus Livius, and repair the mutilated monument of his history in much the same fashion as if a pillar of brick were substituted instead of a column of the Parthenon. Modern writers have only one advantage over these Latin compilers; that of preserving an uniform style in their compositions, and never betraying in their sickly restorations the imposing vicinage of the ancients. Whether they confine themselves to translation, or attempt to complete what has been left unfinished, the edifice is all trowelled with the same mortar; and if it has neither majesty nor solidity, its distribution at least may present an appearance of regularity. But if, in an access of hallucination, it should enter into the mind of a modern to abandon this coarse plastering in order to create in his turn; in short, to construct a rival monument to that of Titus Livius; his folly would be the same as that which the viceroy of Egypt might be charged withal, if he should take a fancy to raise new pyramids beside those of Djizeh, or to surpass the wonderful masses which traditionally own Cheops or Cephrenes as their architects.

But such was not the conception of Niebuhr. His views on Roman history, at the moment when he undertook to teach it, were very different. If, said he, the masterpiece of Titus Livius were still entire, and presented to us a continuous history, it would be at once extravagant and presumptuous to attempt to imitate it in order to attain its perfection. Such an undertaking would be absurd, even although we could collect materials more abundant than those which he had consulted, or record traditions different from his. If Titus Livius still existed entire, the task of the moderns would, in the view of Niebuhr, be limited to disentangling poetical history from the primary facts preserved by tradition, and applying a critical and inquiring spirit to proud family legends, renowned consulates, imaginary triumphs, and those fallacious notions which have passed from panegyrics and funeral orations into histories. But of that admirable work we now possess only disjointed fragments; and if other indications enable us sometimes to divine its course, it is nevertheless with it as with those ancient aqueducts of which we discover the general direction only because some of their ruined arches appear at various distances in the valley or the plain.

The historian of Rome must have a different object in view; an object which it would be his duty to attain, even if classical literature had still presented itself to our consideration as it did to that of the contemporaries of Augustus. It would be incumbent on him to apply his mind to the critical examination of facts, and to researches connected with institutions of which the indifference or ignorance of authors has suffered the memory to perish. Sallust conceived himself obliged to inform the Romans that their own country might, not less than Greece itself, glory in great actions. All their views were, in fact, fixed on the latter; they disdained their own language; they despised the annals of their country. In vain had the elder Cato written his *Origines*; in vain had some other Romans attempted to create a national history. They had no readers; and perhaps Titus Livius was the first who succeeded in avenging that long oblivion of so many great actions and noble characters. Like a majestic hymn, his narration at once filled the ear and awakened the patriotic feelings of the Roman. He struck a chord to which the hearts of his countrymen responded; and henceforward they despised the subtilties of the Greeks, who, excepting Polybius, occupied themselves with debating questions of fatality on the grandeur of Rome, and who consoled the vanity of their countrymen by announcing, in periods elaborately rounded, that destiny had made Rome the mistress of the world, and consequently that no disgrace attached to their inevitable defeat.

But what really were the ancient institutions of Rome? Was it to these that she owed her success? Could her virtues and the devotion of her citizens fail to triumph over all obstacles? These are questions which never engaged the attention of the Greeks. Neglected by the Romans themselves, the original organization of the state had become a subject of doubt even in the time of Cicero. In regard to all that was known of old Rome, and what still remained of ancient institutions, every contemporary might form a judgment, but few persons paid any attention to the subject; and nothing respecting it was consigned to histories written for a posterity which it was not imagined could ever cease to be itself Roman. None of the authors whose works we possess, either in whole or in part, appears to have thought that it would one day be necessary to learn what every one knew in his time; and that from the division of the people into centuries until the occupation of the day of the citizen, every thing would be an object of research. Titus Livius, moreover, has given himself little or no concern about this species of exposition; anxious only to render his narrative attractive, he has rarely shown himself an archeologist, seldom formed a distinct idea either of the different peoples or states, and never consulted the old inscriptions of the Italic nations, or examined the archives of Rome. Hence it is necessary, by means of research and meditation, to penetrate the sense of detached notices comparatively few in number, and, by combining them together, to retrace the image of what the eternal city was at its birth; to recognise in its primitive population the different elements of the Italic races, and in its institutions the result of this fusion; to follow the progress of both, and, wherever the soil is covered with ruins, to seek under the rubbish for the ancient foundations by which it is still furrowed.

It was on the 26th of October 1810, that, in a masterly and vigorous introduction, Niebuhr unfolded these brilliant and profound views. Their splendour might no doubt prove too much for eyes accustomed only to view Rome through the magnifying glass employed in libraries to decipher ancient manuscripts. The school of routine, in fact, cried out scandal; but elevated minds were more enlightened than dazzled. Niebuhr was listened to; his lectures were numerously attended; and their increasing success gave birth to the first volumes, published in 1811 and 1812, which he afterwards completely recast. The apparition of these volumes was for the time a meteor the reflection of which illuminated all the literature of Germany. They gave rise to profound controversies, to ingenious systems, and to learned philological discussions. Niebuhr himself, without conceding any thing to the criticisms of others, became a severe judge of his own work. He afterwards lamented that at first he possessed only the erudition of a man who had instructed himself; and he had the modesty to compare his own proceedings to the uncertain motions of the sleep-walker, who wanders at hazard on the edge of the roof. But with more justice it may perhaps be said, that in these first essays the lights of his genius were like those brilliant coruscations with which a fiery atmosphere irradiates summer nights without a cloud, and which, so far from keeping to any determinate place, incessantly show themselves at all points of the horizon.

This period of creation and enthusiasm was also marked by other productions. Thus, in the same year in which he naturalized himself in the Rome of Servius Tullius, he navigated with Scylax, interrogated the text of his *Periplus*, and read to the Academy of Sciences a dissertation having for its object to determine the epoch when that work was composed, which, according to him, was the first half of the reign of Philip, or about the 105th Olympiad. A competent judge, M. Letronne, has declared that this dissertation was the best which had yet appeared upon the expedition of Scylax.[1] At this time also he delivered a deliberate opinion concerning the epoch to which the second part of the inscription of Adulis belongs;[2] occupied himself with the geography of Herodotus; determined the state of science in the time of the venerable father of history; threw some light upon the annals of the Scythians, Goths, and Sarmatians; and, lastly, by an ingenious and sound criticism, effaced from the collected works of Aristotle the second book of the Economics, which had beyond all doubt been composed in Asia Minor subsequently to the time of Theophrastus.

Nevertheless, the face of the world was about to change. The finest army which had ever been assembled for the purpose of conquest had just perished amidst the snows of Russia. We have already stated what were Niebuhr's sentiments in regard to France. At this critical moment he united with Arndt, and along with him published a journal entitled the *Prussian Correspondent*. This journal was promptly informed of all events. From Spain to Poland, and from Italy to England, it collected every thing calculated to rouse German valour; it announced or presaged success, published vehement manifestos, inflamed the minds of the youth, revived old resentments, and, in short, prepared a war of extermination. The cabinet of Berlin was not slow in obeying the impulsion thus given. Soon afterwards, Niebuhr, having joined the armies of the allies, assisted at the battle of Bautzen; and at that of Dennewitz he himself laboured with Schleiermacher in raising redoubts on the Creutzberg. But not long afterwards, the king of Prussia, whom he had accompanied into the field, sent him into Holland. This was about the time when the formation of the kingdom of the Netherlands began to be discussed in the diplomatic meetings. Niebuhr hesitated not to express decided disapprobation of the proposed fusion of the two states of Holland and Belgium. He spoke often against this project to the mother of the king, who had admitted him into her intimacy, because she had learned to esteem him; and, not content with this frank manifestation of his sentiments, he placed himself in direct official opposition to the calculations of the statesmen of the moment, founded as these were upon confined views and superficial estimates of national character. But on this occasion mediocrity believed itself superior to genius, and, sixteen years afterwards, Belgium reproduced its protestation written in characters of blood.

In the year 1815, Niebuhr was overwhelmed with severe domestic affliction. He lost his father on the 26th of April, and consequently took no part whatever in the events which followed the return of Napoleon from Elba. Absorbed in grief, he sought consolation in writing the life of the Arabian traveller. This biography is short, and free from declamation; and the style is simple, natural, nay often sublime. No extravagance, no useless details, none of those digressions with which the smallest commentator conceives himself bound to overload the author whom he has made the object of his care, deform this composition. It is even remarkable for its strict impartiality. Carsten

[1] If this assertion be no longer correct, M. Letronne has himself only to blame; for he has published a treatise on the ancient geographers, which is in all respects a masterpiece of erudition. Niebuhr entertained a high esteem for this great scholar, and used to observe, that he alone was worth a whole academy.

[2] See also the Researches of M. de Sacy, and the advantage which M. Champollion-Figeac has derived from these in his Annals of the Lagidæ; a work crowned by the Institute in 1819, and which, notwithstanding the controversies to which it has given rise on some points of chronology, is continually cited as an authority amongst our neighbours the French.

Niebuhr. Niebuhr, the son of a cultivator, died counsellor of state, knight of the order of Danebrog, and member of the principal learned societies of Europe; he had never accepted any other title of nobility, which, in his estimation, would have only served to impeach the humility of his virtuous progenitors. His son, the historian of Rome, was likewise counsellor of state, member of the Academy of Sciences, ambassador, and he had no wish, any more than his father, to be ennobled. Both judged rightly. The one had illustrated his name as far as the Indian Ocean; the other had carried it back to the age of Rhea Silvia. The authority of parchments does not go so far in space, nor ascend so high in time. A few weeks after the death of his father, Niebuhr had to lament the loss of his wife. To her, however, the historian consecrated no biography. The gentle virtues of the female sex, concentrated around the domestic hearth, seek no illustration, and their remembrance rarely survives even in those families the happiness of which they had most essentially contributed to promote.

The new tempest which had in the interval exhausted itself, awakened all sorts of ambition, and the conquerors were disputing with avidity the division of the spoil, or, in other words, that of continental Europe. Niebuhr took a part, somewhat too active perhaps, in favour of the ambitious pretensions of Prussia, and wrote, in a vehement style, a pamphlet, entitled *Prussens Rechte gegen den Sächischen Hof*, or Rights of Prussia against the Court of Saxony. But he at the same time showed himself the courageous adversary of M. de Schmaltz, and the stedfast supporter of all the patriots. So much nobleness of character was not calculated to endure long the atmosphere of courts. The virtue and the frankness of Niebuhr annoyed the ministry; and although his services had entitled him to aspire to the highest dignities of the state, it was now resolved to remove him. His mission to the Holy See may therefore be considered as only an honourable exile. But to Niebuhr the employment which removed him from Berlin to Rome was any thing rather than a subject of regret. He felt himself as it were drawn towards that intellectual fatherland which had given him erudition. In the city of the pontiffs he discerned from afar the vestiges of the *enceinte* of Servius Tullius, and occupied himself with the forum and the tribune or pulpit whence harangues had been delivered to the people, much more than with the chair of St Peter, with which he had to negotiate the interests of the Catholic subjects of Prussia. By this time his scientific activity had resumed all its vigour, and, notwithstanding the distractions inseparable from the new union which he wished to contract with the grand-daughter of Dr Hentzler, he began his relations with the celebrated Angelo Maio by publishing the fragments of Fronto, which that learned Italian had just discovered. Associated with him in this undertaking were Buttman and Heindorf, men of a kindred stamp, and, along with the historian of Rome, forming a triumvirate of which the learned in Europe will not soon lose the remembrance. About this period, also, Niebuhr read to the Academy of Sciences a dissertation on some scenes audaciously interpolated into the text of Plautus by the insipid versifiers of the middle ages.

The science of law was then in course of being enriched with the fine conceptions of M. de Savigny. Niebuhr felt inspired by his conversation; he venerated the jurisconsult, and cherished the friend. M. de Savigny engaged him to visit several libraries of Italy, conceiving that they still contained, or rather concealed, valuable remains of the ancient jurisprudence. Niebuhr stopped only a few days at Munich, where he again saw Jacobi, one of the men whom he esteemed the most; then crossing the Brenner, the limit which he had assigned to the ancestors of the Etruscans, he traversed the Tyrol, and having arrived at Verona, almost immediately discovered the Institutions of Gajus, the prototype of those of Justinian. They were found on a palimpsest or rescribed manuscript, which had for ages remained unnoticed in the library of the chapter.

During a residence of seven years in the ancient capital of the world, Niebuhr enjoyed almost uninterrupted happiness. He cherished his young children, and her who gave them birth. His house was open to his countrymen; it was the resort of artists and learned men of all descriptions. The hour propitious to discovery had arrived; Niebuhr, attempting to glean where the celebrated Maio had reaped, published the *Fragmenta Ciceronis;* and if the most entire concord did not always subsist between these learned men, it is nevertheless agreeable to find them united by the most brilliant discovery of our time. When the learned Italian had recovered the Republic of Cicero from beneath some commentaries of St Augustin,[1] Niebuhr furnished notes to the first edition, discussed and restored some of the passages which had been most altered or vitiated, and by his ingenious conjectures contributed to advance the science of philology.

Niebuhr, having greatly modified his ideas in regard to France, now observed with much interest the progress of constitutional opinions. Nevertheless, being attached to all governments consecrated by time, he was desirous that the old dynasties should strike their roots deep into the soil of constitutional Europe. In his opinion, too much blood had already been mingled with that soil to run the hazard of shedding more. He had accordingly an equal aversion to revolutions on the one hand, and to the excess of power on the other; and hence the distinguished orator who declared from the French tribune that it was necessary "to plant the royal standard in the midst of the nation," expressed the opinion of Niebuhr with all the eloquence and majesty of an ancient. The vehement and warm improvisations of M. de Serre; his noble and generous views, so often developed in the most brilliant harangues; obtained for him the esteem of the ambassador of Prussia. The latter saw in him a Roman of the best days; and when, like himself, repulsed by courtiers incapable of entertaining elevated conceptions, M. de Serre was sent to Naples, the French envoy appeared rather to arrive from another time than from another place. These men were soon connected by the ties of the closest friendship; and when a premature death had taken from France one of her noblest sons, Niebuhr formed the design of writing the history of his life, and never afterwards spoke of him without the deepest emotion.

It was in the year 1823 that Niebuhr took his departure from Rome, after having passed there seven years, the whole of which period had been devoted to the cultivation of the sciences. During this long residence, a great number of important dissertations increased the claims which Niebuhr had already acquired to the admiration of learned Europe. In 1819, we find him discussing the merit of the Chronicle of Eusebius, and endeavouring to ascertain what advantage chronology might derive from the discovery which had just been made in the Armenian convent at Venice. Not long afterwards, he determined the epoch in which Quintus Curtius lived, and that in which Petronius wrote. In elegant and easy Latin, he also explained the restitutions of which the inscriptions brought from Nubia by M. Gau appeared to him to be susceptible, and read this beautiful production to the Academy of Archeology. A Ger-

[1] The writing superimposed appeared to belong to the tenth century, and contained the commentaries of St Augustin on the Psalms, from the 119th to the 140th inclusive.

man bookseller intending to have the topography of Lalande reprinted, Niebuhr strenuously opposed the design, and wrote on the subject a learned and luminous *monography*, which appeared in the *Kunstblatt* of Tubingen, and is also inserted in the collection of his works. Lastly, it was by his counsel and encouragement that Platner and Bunsen undertook the important work, which is still, we believe, in course of publication, and which will in all probability be the more perfect that M. Bunsen succeeded Niebuhr in the embassy, and consequently was placed in a situation to continue the researches of his illustrious predecessor on the topography of Rome. The demission of Niebuhr appears to have been principally occasioned by the injurious influence of the climate of Rome on the health of his wife. But it is also possible that a little jarring or asperity in his diplomatic relations may have deprived him of the favour of the court. He feared not to plead the cause of humanity, and though he had not been called to the congress of Verona, he remonstrated in favour of the Greeks, whom a policy equally ridiculous and barbarous had abandoned to the legitimacy of the Turkish sabres.

Before quitting Italy, Niebuhr proceeded to visit Naples, Pompeii, and M. de Serre; he collated a manuscript of the grammarian Charisius, and then set out for Germany, without any determinate project as to his future establishment. Nevertheless, he resolved not to pass by Saint-Gall, where discoveries so important had been made in the fifteenth century. In this ancient monastery he remained for some time, but only obtained by his researches a few obscure fragments of the poem of Merobaudes, which he published the same year, 1823. From Saint-Gall Niebuhr made a sort of pilgrimage to Heidelberg. The celebrated Vossius then resided in that city, and the ambassador of Prussia, the academician, and the historian of Rome, went to carry to this old friend of his father the grateful homage of the young student of Hamburg. After this act of piety almost filial, he directed his course towards the provinces of the Rhine, there to await the orders of the king, and also because he entertained an anxious wish to visit Paris, and make the acquaintance of those learned men whose communications had served to gladden the last years of his father's life. He was also desirous to converse with M. Letronne, whose positive erudition corresponded to the conscientious exactness of his own, and each of whose dissertations presented all the characters of mathematical demonstration. France then inspired him with the most lively admiration. She was rich in all kinds of scientific glory; but the reading of hieroglyphics (which, however, does not belong to France as a discovery, but to England and Dr Young) was, in the estimation of Niebuhr, the most splendid achievement of the erudition of our time.

Detained at Bonn by fortuitous circumstances, he immediately set about continuing his Roman History, the preparation of which had suffered considerable interruption. His residence at Rome did not admit of that assiduous labour, or that accurate examination of books, required by the publication of a history; he was only occupied in receiving impressions, and in studying monuments. On the other hand, he still hoped one day to rekindle those inspirations with which his mind had been originally filled and delighted by the conversation of Savigny. The third volume of the History of Rome was prepared during the winter of 1824, and Niebuhr was about to publish it, when he was recalled to Berlin, where he took part in the deliberations of the council of state, and where, also, he was honoured with the favour of the prince-royal. He had perceived, however, that the publication of his third volume would require that the two preceding ones should be completely recast. This he accordingly undertook in 1825; and the gratuitous courses of lectures which he delivered facilitated his task. Pyrrhus said to his Epirotes, "You are my wings." The zealous professor was animated with the same feeling towards pupils whom he loved, and who listened with their whole souls to his discourses. What distinguished his prelections was not precisely eloquence, to which he made no pretensions. It was a sort of inspiration; it was the richness and abundance of matter; it was, in fine, the air and tone of earnest conviction, a quality which never fails to make a deep impression, though it may sometimes be pushed too far. Whenever he had apprehended and made himself master of a subject, his opinion became to him like an article of faith; his persuasion was complete.[1] It may easily be supposed, therefore, that the attacks directed against his fundamental ideas made very little impression on him. During the twelve years which had elapsed since his work first appeared, it had given occasion to a great deal of discussion. M. de Schlegel, in particular, had, in his Annals of Heidelberg, claimed for Greece the honour of having given birth to the "*poemplu-roi*;" but the article in which Niebuhr examined those national songs and traditions which surround the cradle of Rome with a flickering and uncertain atmosphere appeared to him a work of extraordinary merit. Three years afterwards, Professor Wachsmuth, a man of positive and severe erudition, wrote a history of the Roman State, in which he constantly advances alongside of his adversary, attacks him without intermission, re-establishes what he had overturned, and pulls down what he had built up. In none of the editions of his first volumes which he afterwards published, did Niebuhr make any mention of these formidable antagonists. On the contrary, he affected silence in regard to them, notwithstanding he had engaged in a warm controversy with Steinacker, Francius, and Blum, on the celebrated passage in the republic of Cicero, containing details respecting the comitia. Some years before his death, Golbéry asked him, if, in his second edition, he would not reply to Schlegel and Wachsmuth. At this question his countenance became clouded with an expression of dissatisfaction, and he answered drily that he would name no one.

The man who believes in the knowledge he possesses as the Moslemin confides in the Koran, cannot fail to be exclusive. Unfortunately this was the great defect of Niebuhr. He kept too much aloof from other men of learning, nay, even from those whose labours do honour to their country, whenever the shock of opinions, or a different system, interposed to wound his orthodoxy. It would be endless to enumerate all his antipathies, or to name the distinguished professors with whom he was at feud. It is more satisfactory to state, that his aversions were not of long duration, and that, if prone to take offence, he was equally ready to forgive. In his correspondence with Golbéry, which, on one occasion, had assumed a tone of vivacity, if not a controversial character, Niebuhr observes, with equal justice and discrimination, "It often happens in literary discussions, that a moment of passion, or a transient irritability, leads us to give pain to a man who is otherwise the object of our esteem. Of this there have been numerous instances, from the stormy contentions of the Forum to those of the Chamber of Deputies, and, in philology, from the time of Laurentius Valla to that of Hermann. I experience the regret which accompanies these unfortunate displays of vivacity; I feel satisfaction in seeing the remem-

[1] To one of the most esteemed of the French savans, who, on a particular occasion, stated various objections to his secular cycle, Niebuhr replied, that it was with him a matter of conscience.

Niebuhr. brance of them completely effaced; and my gratitude to him who seeks to re-establish what appeared to me destroyed, enhances the feeling of respect with which his good qualities had otherwise inspired me." Few men possess the candour and the magnanimity thus to acknowledge their failings. On more than one occasion Niebuhr essentially obliged those persons of whom he conceived that he had most reason to complain. With regard to that class of critics who have no other authority than what they derive from their bookseller, Germany, more perhaps than any other country, is a prey to their impudent presumption. For this class of writers Niebuhr had such thorough contempt that he rarely looked into the periodical publications, and almost never read those analyses which are denominated reviews.

In publishing his second and third editions, Niebuhr was far from extending this just disdain to the estimable men who had contested some of his discoveries; he only pretended that what they had attacked in their criticisms was not the weak side of his work. Hence he did not think it enough to persist in the greater part of his results; he had new proofs to produce, and new solutions to give. At the same time, he freely abandoned a fundamental idea of his original essay. In his eyes Rome was no longer Etruscan, but formed by an union of the Etruscan element with the Sabines and the Latins. His residence in the ancient capital of the world had enabled him to illustrate some points which were formerly obscure; and since the commencement of his researches, three new and abundant sources of information had been opened by the publication of Lydus, of Gajus, and of the fragments of the Republic of Cicero; whereas, previously, ages had passed away without adding any thing to the means of extending our knowledge. But it is only by study that his book can be understood. The perusal of it is difficult, nay, even painful; nor can the meaning of the author be discovered or appreciated, except by those who have thoroughly mastered the ancient texts. The quaint archaism of the phraseology also serves as an additional obstacle to its intelligibility. To him may justly be applied what Cicero said of the first orators of Attica; in them we remark noble expressions, a great abundance of ideas, many things in few words, and withal a little obscurity.[1] The inspiration which is most familiar to the author often blends itself with this obscurity, and Niebuhr then appears to give out oracles. But if in the expression there be any want of finish or precision, or any thing which subjects the mind to a labour of divination, such deficiency is compensated by the elevation of the thought, and by a penetration hitherto without example. The defects of his style are still more sensibly felt in the French translation, because the language of our neighbours, always clear and precise, does not naturally admit of vague and uncertain forms of expression; and because, in requiring an author to make an entire disclosure of his thought, it had to undergo no small violence in order to accommodate the expression to the standard of the German original. This inconvenience it was almost impossible to avoid, without injury to the peculiar character of the work. Niebuhr, whose mind was in other respects so elevated, was not less the proprietor of his words than of his ideas, and without accepting the one we could not be enriched with the other. France, however, required a translation, and one almost interlineary was produced, resembling somewhat the versions of Homer which are put into the hands of scholars. The book, in short, was intended for science, not for literature; although this circumstance, which is distinctly stated in the preface, has been lost sight of by some who have criticised it. The English translation is of a different character, and executed on an opposite system, with singular ability and success. It exhibits the History of Rome in a cognate idiom, admitting the transfusion of much of the peculiar spirit of the original; and it contains as full and complete a reproduction of its characteristic qualities and excellencies as it is perhaps possible for any translation to do. As to the original itself, it is undoubtedly a masterpiece; "a foundation for all ages," but, unhappily, "without a superstructure." If Montesquieu takes the flight of the eagle, Niebuhr has the eagle's eye. We may contest some of his opinions, or apply his method to science in order to make new conquests; but, to use the expression of a learned critic, "on passera sur sa trace, sans jamais l'effacer."[2]

Niebuhr made immense sacrifices for the prosperity of the university of Bonn. He gave public courses of lectures, although he did not occupy a chair in that seminary; and from his appointments as counsellor of state he founded prizes on different questions of history and philology, which he proposed for competition to the students. As soon as he perceived in the latter indications of merit, his purse was open to them; in him they found at once a patron, a director, and a friend. He only quitted his new residence twice; once to undertake a journey to Berlin, of which we have already spoken; and some years afterwards to conduct his wife into Holstein, and there to seek the repose rendered necessary by the excessive labour he had undergone. It has been remarked as a proof of his modesty, that, in passing through Göttingen, he inscribed his name on the register of the library, with the addition of Private Teacher at Bonn.

The last period of his life was not the least laborious, inasmuch as he then conceived and executed the project of reprinting the authors of the Byzantine Collection. The most celebrated philologists in Germany were associated in this enterprise, and the learned M. Hase was enabled to restore to erudition his *Leo Diaconus*, the first edition of which had been lost by shipwreck. Niebuhr himself commenced the collection by the publication of Agathias; he superintended the impression of many other authors; he enriched with prefaces a number of the volumes; and by his counsels he directed the labours of his young friends Schopen and Classen. Niebuhr had also established the Museum of the Rhine, a periodical publication, which he enriched with most learned dissertations. He there demonstrated that Lycophron was only contemporary with Philip the son of Demetrius; and that he had been erroneously confounded with the tragedian of Alexandria. Availing himself of a passage of Tzetzes and of a scholium, he discovered an important fact in Italic history. In another dissertation,[3] he compared some fragments of Teles with an obscure passage of Athenæus, and determined the precise war which the latter calls Chremonidian. As to Chremonides, who gave it his name, Niebuhr makes him a general in the service of the king of Egypt, and refers the events in question to a period close upon the 127th Olympiad. Lastly, the Abatte Maio having discovered a fragment of Dion Cassius, Niebuhr, notwithstanding multiplied *lacunæ*, restored the text with singular success, and demonstrated its importance to Roman history, particularly in reference to the quarrels of the tribunes with the senate on the subject of the abolition of debts, the capture of the Janiculum, and the *Lex Hortensia*.

Amidst these multiplied occupations, the second volume of his Roman history was in its turn recast, and the manuscript had already been prepared for the press, when, on

[1] Brutus, *De Claris Oratoribus*.

[2] M. Lerminier, in *Le Globe*.

[3] Both these dissertations were, in 1826, translated into French by M. de Golbéry.

the 7th of February 1830, a night of disaster destroyed the fruit of so much labour. A violent conflagration consumed the upper floors of the house which Niebuhr had destined to be the asylum of his old age. This severe calamity obliged him to recommence his volume entirely, and he passed several months in this painful occupation. His faculties were even affected by the toil which it imposed: "I advance," said he, "by means of efforts which I may venture to call excessive; my memory is impaired to such a degree that I can no longer deceive myself as to the cause of this decay." We have already stated that Niebuhr was of a very feeble constitution. He was of small stature, with a quick and keen eye; his countenance was agreeable, and of a mild expression. The family affections constituted his whole happiness; and the most profound studies never prevented him from smiling on his infant children, or calling to his arms his little Marcus, whose interesting figure, happy disposition, and amiable character, struck every person who saw him beside his good father, a man as deserving of the domestic happiness he enjoyed, as of the great reputation he had acquired. "Twice during my residence at Bonn," says M. de Golbéry, "I went to see him; and of both visits I retain recollections that can never be effaced. The conversation of men such as Niebuhr is an advantage rarely enjoyed; the hours passed in listening to him have left in my mind an impression at once delightful and solemn; he appeared to me simple and good. During my first visit he related to me the history of his whole life; several of the facts and judgments contained in my notice of him I owe to that conversation; but, in my sketch, they are presented without that charm of expression, and that elevation of thought, which caused me to forget the flight of time; and the approach of night alone apprised me that one of the longest days of summer was drawing to a close."

Niebuhr had not yet recovered from the effects of the excessive labour to which the destruction of his house had condemned him, "when," to use the expression in the preface to his second volume, "the madness of the court of France broke the talisman which kept enchained the demon of revolutions." The news of the ordonnances of July had filled him with indignation; and in his public course he made a vehement address to his pupils, in which he spoke of the perversity of a ministry that sacrificed to despotic and sacerdotal notions the happiness of a nation and the imprescriptible freedom of thought.[1] The sagacity of Niebuhr did not, however, enable him to foresee the true results of that unparalleled act of audacity and folly. He was strangely surprised when, three days later, he received intelligence of the events which had occurred in Paris. Niebuhr regarded the rights of nations as sacred as those of kings, and, as a vindication of the former, he applauded the principle of the Revolution of July; a principle, we may add, which was speedily disregarded by the government which that great popular commotion installed on the ruins of the oldest dynasty in Europe.

So much agitation, disquietude, and labour, rendered it impossible for him to receive very strong impressions without danger; any thing, however slight, which affected his health, might become fatal. Niebuhr often went out to read the journals. On Christmas day he returned with a severe cold from a reading-room, where he had perused with deep attention the pleadings of M. Martignac and M. de Sauzet, which strongly affected him. A slight degree of fever accompanied this cold; but, from the 30th of December, his medical attendant recognized the symptoms of a mortal inflammation. The pain, however, diminished inversely as the danger increased. He preserved to the last moment his reason entire, saw the term of his existence approach without discomposure, and surrounded himself with the objects of his affections. At length, on the 2d of January, at two in the morning, this truly great man breathed his last, and "l'âme du juste alla se confondre dans la divinité, dont elle était une faible mais pure émanation." Madame Niebuhr, weakened by protracted suffering from an affection of the chest, sunk under her sorrow in a few days afterwards; and four orphan children, confided to the care of M. de Classen, were subsequently sent to some relations by the father's side in Holstein.

Niebuhr left but few manuscripts. The third volume of his Roman History, which had escaped destruction when his house was burned, has since been printed; and there exist also some fragments of the fourth volume, but in small number. Much may be expected from M. de Savigny, who was thoroughly cognisant of all the great conceptions of his friend; and from M. de Classen, who, for a long period, had not quitted his house. In his last letter to M. de Golbéry, Niebuhr had offered him additions to the first volume of the Roman History; but it is uncertain whether these were found amongst his papers, or whether he had written the life of M. de Serre, which he had certainly the intention of publishing. There may also be found amongst his papers a project relative to Goethe; it was addressed to M. Schweighœuser, whom he had requested to obtain from the priest of Sessenheim a portrait of Goethe such as he was when his residence at Sessenheim rendered that place celebrated. When this was sent to him, little did either M. Schweighœuser or his friend M. de Golbéry foresee that Niebuhr, who was still in the vigour of his age, would reach the term of his career before the patriarch of German literature, whose likeness he was so anxious to procure. A short time before his death, the Prussian government had engaged him to return to Berlin; but he declared to M. de Golbéry that he preferred the quiet of his retreat, and pursuit of his peaceful labours, to the tumult of the capital and the cares of public business. (A.)

NIECE, a brother's or sister's daughter, which in the civil law is reckoned the third degree of consanguinity.

NIEMEN, a large river of Poland, which rises in Lithuania, where it passes by Bielicka, Grodno, and Kowno; it afterwards runs through part of Samogitia and Prussia, where it falls into the lake called the Kurisch-haff, by several mouths, of which the most northern is called the Russ. This lake communicates with the Baltic.

NIEPER, or DNIEPER, a large river of Europe, and one of the most considerable of the north, formerly called the Borysthenes. Its source is in the middle of Muscovy, and it runs westward by Smolensko as far as Orsa; it then turns south, and passing by Mohilow, Bohaczo, Kiow, Czyrkassy, the fortress of Kudak, Dessau, and Oczakow, falls into the Black Sea.

NIESTER, or DNEISTER, a large river of Polish Russia, having its source in the lake Niester, in the palatinate of Lemburg, where it passes by Halicz. It then separates Podolia and Oczakow from Moldavia and Budziac Tartary, and falls into the Black Sea at Belgorod, between the mouths of the Dnieper and the Danube.

NIEUPORT, a fortified city of the Netherlands, in the province of West Flanders, and arrondissement of Furnes.

[1] Neibuhr had conceived high expectations of the administration of M. de Martignac, who appeared to him the only man destined to realise the conception of M. de Serre, and to rally all Frenchmen round a dynasty which it was the duty of all good men loyally to support as long as it remained faithful to its oaths. He accused of bad faith, both those who opposed to this ministry old obstinacy and the prejudices of the court, and also those who prevailed on the chamber to refuse its support to the discussion of the departmental law. He had unbounded esteem for the fine talents and noble character of this statesman, and was more proud of the approbation which M. de Martignac had expressed of his Roman History, than of any other testimony in its favour.

The environs are unhealthy, from the low situation, which, by the facility of inundation, forms one of the chief means of defence. It is situated at the mouth of the Iser, by which it has water communication with Dunkirk, Bruges, and Ypres. It contains 2600 inhabitants, who are chiefly occupied in the herring and cod fisheries. Long. 2. 39. E. Lat. 51. 7. N.

NIEVRE, a department of France, formed out of the ancient duchy of Nivernois. It extends in north latitude from 46. 52. to 47. 36. and in east longitude from 2. 39. to 4. 6. It is bounded on the north by the departments of the Loiret and of the Yonne, on the east by the Côte d'Or and Saone-Loire, on the south by the Saone-Loire and the Allier, and on the west by the Cher. In extent it is 2953 square miles, or 686,619 hectares, and is divided into four arrondissements, twenty-five cantons, and 330 communes, the population of which amounts to 240,250 persons. It is generally a hilly district, and on the eastern side it is mountainous. Nearly one third of the surface is covered with forests; and as the cultivation is bad, it docs not produce a sufficiency of corn for the supply of the people, what it does yield consisting mostly of oats, rye, and barley, with very little wheat. Some of the meadows on the banks of the rivers feed cows, which, with the produce of the forests, furnish the chief commodities with which the people are enabled to buy corn. There are some mines of iron, the working of which, and converting the raw material into common utensils, furnish the chief employment to the scanty population. Some wine is grown, but mostly of inferior quality, and not adequate to the consumption. By its rivers and canals the department is well supplied with cheap means of conveyance for its wood and its iron. The fisheries on the rivers and the lakes are productive, and in part supply fish to Paris. The department elects two deputies for the legislative body. The capital is the city of Nevers.

NIGER, or, more properly, QUORRA, a great river of Central Africa, the course and termination of which, for upwards of forty years, excited an interest beyond any other question connected with the geography of the globe, excepting perhaps that of the north-west passage. This arose not only from the importance which naturally belongs to the solution of any great geographical problem, but from the various and conflicting theories which had been formed relative to the Niger. The points which so long remained undecided were, whether the large interior river of Africa, first mentioned by Herodotus, and afterwards by Pliny, Ptolemy, Leo Africanus, and others, could be identified with that which we now call the Quorra or the Joliba, which latter is its name during the earlier part of its course; and whether this river lost itself in the great Lake Tshad, Tshadda, or Shary, or terminated in the Atlantic Ocean. These were the main questions which were agitated by geographers; but there were others which occupied no inconsiderable degree of attention, such as, whether it carried its waters under ground through the Great Desert, into the Gulf of Syrtis, or whether it flowed in an easterly direction, and formed a branch of the Nile. But every difficulty has at length been cleared away by the enterprise and perseverance of Britons, and we can now trace the entire line of this great river. To the first question, whether the Quorra be the Niger, meaning by that the river so named in the works of ancient geographers and historians, a negative answer has been very generally given; and with regard to the termination of the Quorra, it has been found to flow into the Atlantic through a number of mouths situated in a delta, at the head of the great gulf of the western coast of Africa. The discovery of the termination of the river which has been so long and so improperly called the Niger, was made by Mr Richard Lander, a very humble but intelligent individual, who, without having any prejudices to gratify, or theory to support, set about the task in a straightforward manner, and accomplished, not without difficulty and danger, an undertaking in which all former travellers had failed, from having fallen victims either to the insalubrity of the climate or the more fatal barbarity of the natives. But before tracing Lander's voyage along the Quorra, it may be necessary to give a short account of what was previously known respecting that river.[1]

Herodotus, in his geographical notice of Africa, informs us, that some young persons belonging to a people who dwelt in the north of Africa, on the borders of the Mediterranean, travelled in a westerly direction from a part of Egypt, un-

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[1] It is singular enough, that two persons in the humble sphere of the brothers Lander should have succeeded in resolving the great problem of African geography, after so many able, accomplished, and adventurous men had failed, or perished in the attempt. Their good fortune entitles them to the distinction of a biographical notice.

Richard Lander was born at Truro, in Wales, on the 8th of February 1804. His parents were in humble circumstances, and his education was accordingly of the most ordinary description. He had an early propensity to wandering. "My rambling inclinations," says he, "began to display themselves in early youth. I was never easy a great while together in one place, and used to be delighted to play truant, and stroll from town to town, and from village to village, whenever I could steal an opportunity; as well as to mix in the society of boys possessing restless habits and inclinations similar to my own. I used also to listen with unmixed attention to old women's tales about the ceremonies and manners of the nations of distant regions of the earth." Domestic calamities compelled him to quit his paternal abode when he was only nine years of age, and at the early age of eleven he accompanied a mercantile gentleman to the West Indies. He was absent three years, and returned to his native country in 1818, where he entered into the service of several individuals, one of whom he accompanied to France and other countries on the Continent. An opportunity having again occurred of visiting distant regions, he traversed the colony of the Cape of Good Hope, as servant to Major Colebrooke, one of his majesty's commissioners of inquiry into the state of the British colonies. On his return to England in 1824, he accepted a situation in the establishment of a kinsman of the Duke of Northumberland, "where," says he, "my time passed away pleasantly and thoughtlessly enough, till the return of Captain Clapperton and Major Denham from the interior of Africa in the following year again roused my rambling propensities." Having heard that it was the intention of the British government to send out another expedition for the purpose of exploring the yet undiscovered parts of Central Africa, he waited upon Captain Clapperton, and was engaged by that enterprising traveller as his confidential servant. The results of this expedition are well known. After the death of Clapperton, on the 10th of April 1827, Lander sought every opportunity of conveying himself home, which, however, he did not accomplish in less than a twelvemonth, having had to make his way defenceless and alone from Saccatoo, in Houssa, to Badagry, on the western coast of Africa, a long, difficult, and dangerous journey. At length he arrived safely at Portsmouth, on the 30th of April 1828, bringing with him Captain Clapperton's journal, as well as a great deal of valuable information of his own. Being unable, from ill health, to superintend the printing of his journal, it was published in the first instance in a rough unfinished form; but it was subsequently revised and given to the world in two volumes octavo. Meanwhile the British government had engaged him to proceed to Fundah, and trace the river Quorra from that place to the sea. It was in this second expedition that he secured to his name the distinguished place which it must ever hold in the history of African discovery.

Accompanied by his brother John, who undertook the expedition without any promise of reward, Richard Lander embarked at Portsmouth on the 9th of January 1830, and arrived at Cape Coast Castle on the 22d of the following month. On the 22d of March the travellers landed at Badagry, where they were detained nine days by the mercenary chief of the place. At length they set out on their toilsome journey; and, after undergoing a variety of privations and sufferings, they, on the 17th of June, reached Boossa, on the western bank of the Quorra, which place no European had before visited except the unfortunate Park, and Captain Clapperton when he was accompanied by Lander. From Boossa the Landers proceeded up the river about one hundred miles to Yaoori, the extil they came to a large river full of crocodiles, and flowing towards the rising sun; and that they were conducted by the natives to a considerable city situated on its banks. The fact of the Nile flowing from the west in an early part of its course, led the Father of History to conclude that this river was a distant branch or source of the Nile. Thus originated the first error regarding the Niger, and the weight which was attached to the opinions of Herodotus (scarcely less than belonged to those of Aristotle in a still more important branch of human knowledge) continued for ages to involve the subject in the greatest obscurity. The successive facts discovered relative to the hydrography of Africa were bent and twisted to answer the conditions of a vague hypothesis, for the truth of which there was no proof, and only the authority of a *name*. Notice is taken of the Niger by Strabo, but Pliny treats largely of this river, conducting it in an easterly direction, through sandy deserts, to the Nile of Egypt, and thus coinciding in opinion with Herodotus. Mela, another geographer, had the candour to confess, that when the Niger reached the middle of the continent, no one knew what became of it. Ptolemy was the first who demolished the notion that the Nile and the Niger are the same; but his account of the Niger is vague, and somewhat unintelligible. He adhered to the former opinion regarding its general direction, and considered as one river streams that were entirely distinct. But to return to Herodotus. The difficulty has been to identify the track of the travellers which he mentions, and their account of what they saw, with what is now known of the river lately discovered, and the part of Africa in which it is situated. Without going into the details of this subject, we may briefly state how the facts stand. Herodotus distinctly mentions, that the Nasamonian youth travelled directly westward; and if so, they certainly could never have reached the Joliba or Quorra. But others assert, that as the ancients were not very accurate with regard to their bearings, the words of Herodotus are not to be interpreted strictly; and consequently, if we allow that they proceeded, not directly westward, but a little to the south, the travellers might have arrived at the river. The city to which they were conducted has been surmised to have been no other than Timbuctoo itself.[1] But it is clear, that if we allow of such latitude of meaning to the terms employed by the ancients, either in geography or any other science, there will be no end to conjecture regarding what they did or what they did not know. If Herodotus is to be taken as authority at all, we must accept of him without any emendation whatever, just as he stands; and if so, we must certainly come to the conclusion, that the Joliba or Quorra is not the great river to which he alludes. It may have been one of the many streams flowing in an easterly direction in that part of Africa which was called Segelmessa; and what seems to confirm this conjecture is, that Pliny evidently points to one of these. The celebrated Arabian geographers Abulfeda and Edrisi, and Leo Africanus, a native of Spain, all assigned to the Niger of Ptolemy a westerly course; and the two former gave it a source identical with that of the Nile, but Leo supposed it to take its rise in a lake situated to the south of Bornou, whence it was believed to flow westward to the Atlantic Ocean. The early European navigators, in their discoveries on the western coast of Africa, found successively the estuaries of the Senegal, Gambia, and Rio Grande, and believed them to be the mouths of the Niger, which was described as traversing nearly the entire breadth of Africa. In course of time they were tempted to explore the Senegal and Gambia, for the purpose of reaching

treme point of the expedition, where they arrived on the 27th of June. The descent of the river commenced on the 2d of August, and the results of the expedition are related in the text. In their voyage downwards to the sea, their adventures were sometimes of an amusing, sometimes of an alarming character. As they proceeded, however, their difficulties and dangers increased; but these were met with the most manly and determined resolution. At Kirree they were plundered, and nearly lost their lives. On their arrival at Eboe, they were made prisoners by the king of the place, who would not consent to their liberation except on the condition of receiving a large ransom. For this sum they gave a bill on the captain of a Liverpool trader, which they ascertained was lying in the river Nun, one of the mouths of the Quorra. An obligation of a similar nature was exacted from them by the king of Brasstown, and John Lander was retained as a hostage; but he contrived to persuade the natives to allow him to proceed. The captain of the Liverpool trader treated them in a most brutal manner, and refused to make any advance whatever, although he was assured of repayment by the British government. Their bills were consequently protested, but the demand was afterwards ordered to be paid by government. On the 20th of January 1831 the travellers proceeded from Fernando Po to Rio de Janeiro, whence they set sail for England, where they arrived on the 9th of June.

The safe return of the brothers Lander, and the triumphant discovery which they had made, was the subject of warm and general congratulation. The Royal Geographical Society awarded Richard Lander a premium of fifty guineas, and for the journal of the brothers one thousand guineas was given by a London bookseller. In the disaster which befell them at Kirree, portions of the journals of both brothers were lost; but fortunately that part of each journal which was saved supplied what had been lost of the other, and a connected narrative was published in three volumes, entitled "Journal of an Expedition to explore the course and termination of the Niger, by Richard and John Lander." The domestic disposition of John Lander induced him to settle permanently at home; but Richard's love of hazardous enterprise had not yet been gratified. An expedition for the purpose of ascending the Quorra having been fitted out by some merchants of Liverpool, he was requested to undertake the direction of it, and he accepted the offer. The results of this expedition, which has been mentioned in the text, were quite unsatisfactory to the projectors, and most fatal to those who undertook it, very few Europeans having survived it. Amongst the victims was Richard Lander. The expedition which entered the river consisted of two steam-vessels, in one of which he ascended the Quorra to the junction of the Tshadda or Shary, where he left the vessel, and returned to Fernando Po, for the purpose of obtaining some medicines and other necessaries. After rejoining his companions, he penetrated up the Tshadda to a considerable distance; but want of provisions compelled him to relinquish any attempt to penetrate to the sources of this river. He proceeded up the Quorra as far as Rabba, where he prosecuted an advantageous trade with the inhabitants. For the purpose of obtaining a particular species of goods for the markets in the interior, he once more descended the river to Fernando Po, from which place his last letter to his friends in England, written in high spirits, was dated. He mentioned that he was then "on his way to the interior for the third and *last time*." It was the last time. The party, which ascended the Quorra in two canoes, was attacked by the natives at a part of the river about seventy miles inland. Several were killed and a number wounded; amongst the latter was Richard Lander, who appears to have behaved on the occasion with the greatest bravery and self-possession. Whilst cheering his comrades, and inspiring them by his heroic example, he received a musket-ball in the hip, which made him stagger; but he continued to direct the movements of his party until the canoes were out of reach of the enemy's shot, when he sunk down exhausted from loss of blood. Having succeeded in escaping down the river to Fernando Po, every possible attention was paid to his wound, and symptoms became at last so favourable, that no doubts were entertained of Lander's recovery. But on the 6th of February 1834 mortification ensued, and so rapid was the prostration of the sufferer, that he died soon after midnight. Thus perished, in the thirty-first year of his age, Richard Lander, the humblest, but in one respect the most fortunate, of all those whose names are associated with the subject of African discovery, and who have fallen victims to their zeal in that exciting but fatal pursuit. His widow received a pension from William IV., and his daughter a handsome donation.

[1] Such is the view taken of this disputed point by Lieutenant-Colonel Leake, in the second volume of the Journal of the Geographical Society. But a writer in the Quarterly Review, whose opinion is entitled to the greatest deference, takes an opposite view, asserting that Herodotus "knew of no such river, nor even mentioned the name." (*Quarterly Review*, No. xci. p. 80.)

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the far-famed city of Timbuctoo, the immense wealth of which excited their cupidity. They traced these rivers so near to their sources as to decrease almost to rivulets, yet still they found themselves very far from the object of their wishes, and the vast central plain through which the Niger was understood to flow. In the meanwhile the French geographers De Lisle and D'Anville devoted their attention to Africa. De Lisle, in a map published in 1714, gave the sources both of the Niger and Senegal, the former being made to flow eastward and the latter westward, which was an approximation to the truth. D'Anville followed up this view in his map of Africa, published in 1749; and thus far a correct knowledge of the source and direction of the Niger was obtained, by its being separated in the east from the Nile, and in the west from the Senegal, and by having an easterly course at first assigned to it.

These views, however, appear to have been lost sight of, and the belief that the Niger followed a westerly course was generally entertained. But the formation of the African Association in England marks the commencement of a new era in the history of African geography. The first and principal object which occupied the attention of this body was the course and termination of the Niger; and a reward was held out to the person, whoever he might be, that should succeed in determining them. We pass over the names of Ledyard and Lucas, the former having died at Cairo before accomplishing any thing, and the latter having only gathered some information from the Arabs, which tended rather to perplex than elucidate the subject. The honour of determining the course of the Niger was reserved for the celebrated Mr Mungo Park, a native of Scotland, who, in the year 1795, offered to the Association his services, which were accepted. In his first journey, Mr Park explored the course of the Niger from Bammakoo to Silla, the former being, according to his account, about ten days' journey distant from its source, and the latter two hundred miles from Timbuctoo. In his second journey, undertaken at the instance of the British government, he traced the Niger as far as Boossa, where he unfortunately perished in the river, as was afterwards satisfactorily ascertained by Clapperton and Lander. After that of Park, the names of Laing, De Caille, Clapperton, and Lander, who all ascertained important facts regarding the Quorra, occur in connection with the discovery of its termination. Clapperton crossed the river at the point where Park perished, and soon afterwards died himself at Saccatoo. But Richard Lander, his faithful servant, on his return to England, volunteered to navigate the river from Boossa to its termination; his offer was accepted by the British government, and in a few months this enterprising individual accomplished the work of ages, having entered the Atlantic by the River Nun, one of the branches by which this great river discharges itself into the sea.

The source of the Quorra or Joliba, although not yet actually explored, has been ascertained by Laing to be situated in the high country of Kissi, about two hundred miles north-east by east of Sierra Leone. The branch of it which is best known is said to originate in the eastern side of Mount Loma, one of the range called the Mountains of Kong, and which appears to be a continuation of the Gibel el Kumri, or Mountains of the Moon, in latitude 9. 15. north, and longitude 9. 36. west. From Loma, this stream, under the name of Joliba, bends its course north-east through Foota Jallo and Kankan, to Couroussa, a town situated about eighty miles east from Timboo, where De Caille, travelling eastward, crossed it, and found it, before the inundation commenced, to be 900 French feet in breadth, and nine feet in depth, with a current of two miles and a half per hour. From its great size here, only one hundred miles from its reputed source, it must have received the waters of some tributary streams; indeed, before reaching Bammakoo, it receives the Tankisso and Sarano, both of which are large rivers, one of them, flowing from Sankari in Manding, having been mistaken by Park for the Joliba itself. At Bammakoo it commences its course over the plain of Bambarra, flowing still in an easterly direction, by Yamina, Sansanding, and Sego, the capital, where it forms a noble stream, equal to the Thames at Westminster. It pursues the same course till it reaches Jinne, when it takes a bend nearly due north, in which direction it flows till it reaches Lake Dibbie, when it reverts to its easterly bearing, and continues to run in that direction till it reaches Timbuctoo. De Caille navigated the river from Jinne to Timbuctoo, and represents the banks between these places as low and marshy. Lake Dibbie is of very considerable magnitude, and stretches from east to west instead of from north to south. Below this the river was found very deep, and from half a mile to a mile in breadth, with a considerable current. Near Kabra, the port of Timbuctoo, the Joliba separates into two branches, the larger, which is about three fourths of a mile broad, bending its course east-south-east, and the smaller, about a hundred feet broad, but very deep, taking its course east by north to Kabra. The celebrated city of Timbuctoo is about eight miles north from Kabra, and, from the most accurate information which has as yet been obtained, stands in latitude 17. 30. north, and longitude 2. 30. east. From Kabra the smaller branch of the Joliba turns south-east, and joins the parent stream to the eastward, from which point there is reason to believe, although its course has not been delineated, that the Joliba flows in the general direction of its course south-east till it reaches Yaoori. From Timbuctoo to Yaoori, however, very little is known of this great river; but the fact that Park sailed down from the one place to the other fully establishes the continuity. From Yaoori to the sea it was navigated by the Landers, and was found to flow at first nearly due south, then to take a rapid bend to the east, and afterwards gradually to return and take a south-south-westerly direction to the Atlantic Ocean. Of these fortunate discoverers we shall now proceed to give some account.[1]

Boossa, the first city in the vicinity of the Quorra, at which the Landers arrived, is situated on its right bank, about a mile from the river, in latitude 10. 14. north, and longitude 6. 11. east. Black rocks were seen to rise abruptly from the centre of the stream; its surface was agitated by whirlpools; and in the dry season its largest branch was not more than a stone's throw across. The travellers proceeded in a canoe from Boossa to Yaoori, between which places the river was found divided into many channels, by rocks, sand-banks, and low islands, covered with tall rank grass; and some of the channels were so shallow that their canoe was constantly grounding. They were told at Yaoori, however, that above that place, and below Boossa, the navigation was not interrupted either by rocks or sand-banks; and that after the *malea* or wet season, which sets in with fourteen days of incessant rain, canoes of all kinds pass to and fro between Yaoori, Nouffe, Boossa, and Fundah. Yaoori is a large flourishing kingdom, ruled by a hereditary sovereign, who exercises absolute despotism. The capital city, which bears the same name, is of great extent, being between twenty and thirty miles in circuit, and very popu-

[1] When the articles Africa, Benin, and some others connected with the geography of this quarter of the globe, passed through the press, the result of the Landers' expedition was not known; so that a more ample narrative of their discoveries is necessary in this place, to supply any deficiency which may be found in our geography of Africa.

lous; but, from the low nature of the banks of the river, it was found very swampy. Returning to Boossa, and sailing downwards, the Quorra was found completely navigable to a finely-wooded island called Patashie; but from thence to Lever or Layaba, a distance of about twenty miles, the channel is so full of rocks and sand-banks, as to render the passage very difficult. From Lever all the way down to the ocean, the Quorra is a broad and noble stream, varying from one to six, but being most commonly between two and three miles in breadth. The banks in some places were flat and marshy, but elsewhere presented the most pleasing aspect. They are described as "embellished with mighty trees and elegant shrubs, which were clad in thick and luxuriant foliage, some of lively green, others of darker hues; and little birds were singing merrily among the branches. Magnificent festoons of creeping plants, always green, hung from the tops of the tallest trees, and, drooping to the water's edge, were pleasing and grateful to the eye." Further down, the river is bordered by lofty mountains, seemingly forming part of the great chain which crosses Africa in this latitude, but which has not been sufficient to arrest the course of this mighty stream. These eminences are described as gloomy and romantic, fringed with stunted shrubs, which overhang immense precipices; and their recesses are tenanted only by wild beasts and birds of prey. Even in the mid-channel, a rocky islet called Mount Kesa rises to the height of 300 feet; and its steep sides, fringed with magnificent trees, present a majestic appearance. The island Zagoshie is one of the most remarkable spots in all Africa. It is about fifteen miles in length and three in breadth, in the midst of the Quorra, the broad channel of which on either side separates it from the continent. The surface is very low, and muddy, yet throughout well cultivated, and extremely productive. The manufactures of this place are highly valued, and superior to any in the kingdom of Nouffe or Tappa, to which it belongs. The largest and most flourishing city of this domain is Rabba, situated about two miles from Zagoshie, in latitude 9. 14., and between five and six hundred miles from the sea. The surrounding country abounds in the most valuable grains, in horned cattle of remarkable size, and in horses much admired for their strength and beauty.

Below Zagoshie and Rabba the Quorra flows almost due east for upwards of a hundred and twenty miles, presenting throughout a magnificent body of water, at one place nearly eight miles broad. The shores are generally well cultivated and inhabited; and at one point two very large cities appeared on the opposite banks. Towards the end of this reach the Quorra is joined by a large stream from the north-east, called the Coodonia. About twenty miles lower is Egga, a very large town built close to the river, in a situation low, and liable to inundation. The inhabitants trade both up and down the river; and here were found Portuguese cloths, brought from Benin. Egga is the boundary town of Nouffe, and closes on the south that range of flourishing and comparatively well-governed countries which here extend along both banks of the Quorra. The river now flows east-south-east along a fine country, covered with numerous villages, the principal being Kacunda, which consists of three large villages, all under the absolute sway of a single chief. The river then takes a direction nearly due south, and, at the distance of three or four days' journey below Egga, is joined by another river nearly as large as itself, falling in from the north-eastward. This is the Tshadda, Shar, or Shary; and Lander was informed that Fundah, of which Clapperton heard so much when at Saccatoo, was at the distance of three days' journey on the banks of this river, and not, as had been supposed, on those of the Quorra. This fact was verified some years afterwards by Mr Laird,[1] who, in his voyage up the Quorra, ascended the river Tshadda (uniformly designated Shary in his work) for six or seven days, when he entered a creek, from the extremity of which a land journey of about ten miles conducted him to Fundah, a large and populous town. Below the confluence of the rivers Quorra and Tshadda the course of the river is south-south-west, and

[1] See Narrative of an Expedition into the Interior of Africa, by the River Niger, in the steam-vessels Quorra and Alburkah, in 1832–33–34, by Macgregor Laird and R. A. K. Oldfield, surviving officers of the expedition, London, 1837, in two vols. 8vo. With regard to the source of the Tshadda our information is meagre and inconclusive. Mr Laird made many inquiries respecting it, and the invariable answer was, that it came from the great Lake Tshad or Tchad. One person, indeed, a native of Kooka, offered to take him up there in twelve days, without changing the canoe. The confidence of this assertion is very much like that of a person who had already performed the voyage; but, from the mendacious propensities of the natives, Mr Laird is not inclined to admit the correctness of this account, and thinks that the river has its rise in another and very different quarter. Fortunately he assigns his reasons for drawing this conclusion, by which we are enabled to form an independent judgment on the point.

"The water of the Shary," says he, "is colder than that of the Niger. The rise of the river commences sooner and more suddenly than the Niger. There is little trade upon the Shary in comparison with the Niger, which, if it communicated with the Sea of Soudan, would naturally be immense. From the three first reasons, I should think that its rise is in a mountainous country, and that that country lies very near the equator." With all deference to this judicious traveller, we think that at least two of his reasons for differing from the popular opinion go directly to confirm it. In the first place, the water of the Shary being colder than that of the Quorra, is just what would happen if the source of the river were a large reservoir of water, such as we know the Lake Tshad to be. A great body of water, as is well known, is kept permanently colder than a small one under the same circumstances; the stream issuing from the former, therefore, and flowing only 500 miles (which is probably more than the limit that ought to be assigned to the course of the Shary, supposing it to originate in Lake Tshad), will beyond all doubt be colder than one which has traversed nearly 3000 miles in a tropical climate, becoming swelled during its long course only by a great number of small tributaries, and, from its shallow depth when compared to a large inland sea, having its temperature raised considerably higher by the influence of the solar beams. Secondly, the rise of the river taking place *sooner* than is the case with the Niger, and also more *suddenly*, clearly proves, that at the commencement of the wet season it receives all at once a great accession to its waters, which would be the case if it flowed from a large lake into which a number of large rivers, having short courses, discharged their waters simultaneously; and, according to the best authorities, Lake Tshad is the basin into which a great number of streams from the surrounding country are poured, these, when compared with the Quorra, or even with the Shary, having but short courses. The river Quorra, on the contrary, becomes augmented in size by a multitude of smaller streams which enter it at different intervals during a course of nearly 3000 miles; consequently they must affect the main stream, at its confluence with the Shary, slowly and gradually, *not all at once.* Besides, it appears from the facts of the case, that before the tributaries which join it previously to its reaching Timbuctoo have taken effect at the point referred to, a considerable portion of what may be called the overplus waters received during the rainy season, and joining the Quorra *below* Timbuctoo, has already partially augmented the parent stream at its junction with the Shary, and passed on to the Atlantic. The two reasons which Mr Laird brings forward as opposed to the opinion of the Shary being a river flowing from Lake Tshad, seem to us therefore to be remarkably favourable to such an hypothesis. Indeed, in the absence of direct evidence to the contrary, we are strongly inclined to think that this is the fact. With regard to Mr Laird's third reason, that the trade on the Shary is smaller than it would be if it communicated with Lake Tshad, nothing satisfactory can be advanced until we know more of the countries in the interior. Lander was informed that the Tshadda or Shary flowed through large and fruitful kingdoms, and that an extensive commerce and active navigation were carried on by means of it. We can see nothing in its mere trade to make either for or against its originating in a great lake, providing it be navigable to a great distance into the interior of a populous country; and this is certainly the case.

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its width, as usual, varies from two to five or six miles. Opposite to Bocqua, a considerable town situated below the junction of the Tshadda, is the common path to the city of Fundah; and here both banks of the river continue hilly and well wooded, and are thickly studded with towns and villages. Of this town Mr Laird observes, "Bocqua, or Hickory, as the natives call it, is the centre of this trade (in slaves, cloth, and ivory), and a fair of three days' duration is held there every ten days, attended by Eboe, and Attah, and even Bonny traders from the south, and those from Egga, Cuttum-Curaffe, and Fundah on the north [north-east?], besides great numbers from the interior country on both banks of the river. The traders from the upper country bring cloths of native manufacture, beads, ivory, rice, straw-hats, and slaves, all of which they sell for cowries, and buy European goods, chiefly Portuguese and Spanish. About twenty-five large canoes passed us every ten days, on their way to this market, each containing from forty to sixty people. The trade is carried on by money, not by barter; cowries are the circulating medium, and their sterling value on an average may be taken at one shilling per thousand." Still farther down is the town of Attah or Iddoh, picturesquely situated on a hill overhanging the river, in some places with cliffs 300 feet in height. Standing above the alluvial soil at the entrance of the valley of the Quorra, and thus removed from damp, it is healthy, and, according to Mr Laird, commands at present the whole trade of the interior. The same traveller informs us, that above this town the river forces its way through a chain of mountains which he calls Kong, being in all likelihood a part of the range already mentioned as traversing this part of Africa. They seemed to be of nearly equal height, apparently from 2500 to 3000 feet above the level of the river, and had all flat summits. They are probably composed of sandstone resting upon granite, of which latter rock large masses were found in the vicinity of the river. About forty-five miles below the junction of the Tshadda with the Quorra, and on the left bank of the latter river, stands the town of Abbazacca; and still farther down Damuggoo, at which place Lander found that the Quorra fell two feet in as many days, yet still overflowed the town. European goods here made their appearance in considerable abundance, consisting of powder, muskets, soap, Manchester cottons, and other manufactures, together with large quantities of diluted rum, in all which articles the natives trade to Bocqua, where they receive in exchange ivory and slaves, which, again, are sold to European traders. Some ten or fifteen miles below Damuggoo a stream flows in from the eastward; but this, Lander thinks, is a branch previously separated from the main stream, and on his map it is made to enclose the large towns of Abbazacca and Damuggoo, together with a number of villages. At the reunion of this stream with the Quorra stands Kirree, a large market-town, at which place the great delta of the Quorra may be said to commence, extending south-westerly to the mouth of the river Benin, and south-south-east to that of Old Calabar. At Kirree a great branch was seen to go off to Benin; but it is not till the traveller reaches Eboe, a large town seventy miles farther down the river, that it begins to separate into those numerous channels which intersect the country in every direction, and enter the Atlantic by so many estuaries. At a little distance above Eboe a large branch runs to the westward, terminating also, it is said, at Benin, but more probably in one of the numerous rivers to the south-south-east of that estuary. Another large branch goes off at the same place, flowing to the south-east, apparently towards Old Calabar and the Rio del Rey, two large estuaries. At the point where these two arms of the Quorra strike off, the river spreads out into a vast lake, which is said to receive a number of small rivers.

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In sailing down from Kirree to Eboe, the Landers found a complete change from the beautiful and smiling aspect which nature had presented on the upper banks of the stream. The country became almost throughout an alluvial swamp, covered with vast entangled forests, which concealed the villages. Grain and cattle had disappeared from the fields, and the sole subsistence of the inhabitants was derived from the produce of the trees, from roots, the banana, the plantain, the yam, and from the fish caught in the river. The Quorra abounds in fish, and the inhabitants of the banks are expert and persevering fishermen. They make immense nets of grass, which they use as seines with great dexterity. The palm-tree, also, is not only an extensive article of trade, but affords a refreshing juice. Eboe is situated on the side of a creek running parallel with the Quorra, and in the flooded season communicating with it at both extremities. It may contain about six thousand inhabitants, who are the most enterprising and industrious traders on the river. The town itself, with the immediate vicinity, is unhealthy, owing to the swampy nature of the ground. The staple trade of Eboe consists of slaves and palm-oil, the latter being produced in immense quantities; and yet so plentiful are the trees which yield it, that, Mr Laird says, not the twentieth part of the natural produce is collected. But as long as the slave-trade exists, it is vain to look for the development of industry and commerce in these countries. Is it likely that the natives will explore the palm forests whilst the atrocious practice of kidnapping them on every convenient occasion is carried on by Europeans and Americans? Industry, however, would soon follow security, and the trade in palm-oil might be rendered exceedingly valuable to Europe. Below Eboe, the branches thrown off by the Quorra on both sides are large and numerous, and that which forms the Bonny may perhaps claim to be considered as the main stream. The Brass River, however, flowing in a direction nearly south-west from Eboe, and entering the Atlantic at Cape Formosa, was that by which the Landers reached the sea. The next points to be considered are, the extent of the Quorra, its tributaries, and the size and character of its delta.

"If we measure two distances," says an able writer on this subject,[1] "one from the source to Timbuctoo, and the other from that city to the sea, we shall have nearly 2000 miles, which may be considered as the direct course; and the various windings must raise the whole line of the stream to upwards of 3000 miles. For several hundred miles of its lower course it forms a broad and magnificent expanse, resembling an inland sea. The Niger must, after all, yield very considerably to the Missouri and Orellana, those stupendous rivers of the new world; but it appears as great as any of those which water the old continents. There can rank with it only the Nile and the Yang-tse-kiang, or Great River of China. But the upper course of neither is yet very fully ascertained; and the Nile can compete only in length of course, not in the magnitude of its stream, or the fertility of the regions which it waters. There is one feature in which the Niger may defy competition with any river, either of the old or new world. This is in the grandeur of its delta. Along the whole coast, from the river of Formosa or Benin, to that of Old Calabar, about three hundred miles in length, there open into the Atlantic its successive estuaries, which navigators have scarcely been able to number. Taking this coast as the base of the triangle or delta, and its vertex at Kirree, about a hundred and seventy miles inland, where the Formosa branch separates, we have a space of upwards of 25,000 square miles,

[1] Edinburgh Review, No. cx. p. 415.

equal to the half of England. Had this delta, like that of the Nile, been subject only to temporary inundations, leaving behind a layer of fertilizing slime, it would have formed the most fruitful region on the earth, and might have been almost the granary of a continent. But unfortunately the Niger rolls down its waters in such excessive abundance, as to convert the whole into a huge and dreary swamp, covered with dense forests of mangrove and other trees of spreading and luxuriant foliage. The equatorial sun, with its fiercest rays, cannot penetrate these dark recesses; it only exhales from them pestilential vapours, which render this coast the theatre of more fatal epidemic diseases than any other, even of Western Africa. That human industry will one day level these forests, drain these swamps, and cover this soil with luxuriant harvests, we may confidently anticipate; but many ages must probably elapse before man, in Africa, can achieve such a victory over nature."

These broad estuaries of the Quorra communicate with each other by creeks, and, frequently overflowing their banks, render the shore a vast alluvial wooded morass for more than twenty miles inland. The natives, having thus far extended water communications, are the most active traders anywhere in Africa; but, excepting slaves, the commodities in which they deal are now entirely changed. Gold has given place to ivory, which is collected in considerable quantities; but palm-oil is the great staple of the eastern districts. A vast quantity of salt is made at the mouths of the rivers, both for consumption at the spot and in the interior. The first leading feature is the river Formosa, which is two miles wide at its mouth; and on a creek tributary to it stands the capital of Benin. The surrounding territory is well cultivated, although not so completely cleared of wood as it might be. Jatto, about fifty miles below, is the port of Benin, and is accessible to vessels of sixty tons. The trade on this river has greatly declined from what it once was. Warré or Owarri is another state and city, situated on another creek, communicating with the Formosa on its opposite side. It consists of a somewhat elevated and beautiful island, surrounded by vast woods and swamps. After doubling Cape Formosa, and passing several estuaries, we come to that of the Brass River, called by the Portuguese the river of Nun. This, though not the largest estuary of the Quorra, is most directly in the line of the main stream, and being that by which Lander entered the Atlantic, it at present enjoys the reputation of being the principal channel. It is divided into two branches; but the navigation is greatly impeded, and the trade limited by a dangerous bar at its mouth. Brass Town is not built on either of the great branches, but on one of the numerous creeks connected with both, and in a country overgrown with impenetrable thickets of mangrove. It is a poor place, divided by a lagoon into two parts, each of which contains about a thousand inhabitants. Bonny River forms the next important estuary, having on its opposite sides the towns of Bonny and New Calabar, which, being only a few miles up, are situated in the midst of the morassses which overspread all this country. The people support themselves by the manufacture of salt, and they likewise trade in slaves and palm-oil. To the eastward of Bonny is the estuary of Old Calabar River, the broadest of all, and navigable for large vessels sixty miles up to Ephraim Town, which is governed by a chief who assumes the title of duke. It carries on a considerable trade, and contains about four thousand inhabitants. To this river succeeds that of Rio del Rey, and then the Rio Cameroons. The country yields a good deal of ivory and palm-oil. The continuity of the vast wooded flat which extends along the coast for more than two hundred miles is now broken by some very lofty mountains, the principal of which is supposed to reach the height of 13,000 feet.

We have seen that, besides its own ample stream, the Quorra has a number of tributaries. Not far above the point where the delta commences, the Tshadda enters, being nearly equal in magnitude to the Quorra itself. A little higher up the Coodonia enters; it is a smaller river, but still of great importance in a commercial point of view, as Lander had seen it flowing through a very fertile and highly cultivated country. Considerably higher up is the Cubbie, a large stream from the country and city of that name; and higher up still is the Quarrama, which passes by Zirmie and Saccatoo. Between this point and Timbuctoo we are ignorant of how many or what streams join the Quorra, nor is the tributary which passes that city of any great importance. But, at the eastern boundary of Bambarra, Mr Park describes the influx from the south of two great streams, the Maniand and Nimma; and it seems very doubtful if De Caille was not mistaken in supposing the latter to be a mere branch of the Quorra. The higher tributaries descending from the mountains swell the stream, without themselves affording any important navigation.

An interesting question, and one which has occupied a considerable degree of attention, here presents itself, namely, what prospect does this great interior communication open to British commerce? Our intercourse with this part of Africa has hitherto been almost exclusively with the coast, which is comparatively unproductive, whilst its inhabitants are idle and miserable. Inland, however, we find the people improve, and the country become fertile to luxuriance, and gradually more healthy. The territories rendered accessible by the Quorra and its tributaries are undoubtedly the most productive and industrious in all Africa; and their population, notwithstanding the difficulty of forming any precise estimate, can scarcely be rated at less than about twenty-five millions. Considerable results might reasonably be anticipated, from British enterprise having found access to such a region. But there are two great drawbacks to active intercourse with the interior of Africa; the insalubrity of the climate, and the inhuman traffic in slaves, which last is a thousand times more destructive to trade than all the forms which disease ever assumed. If this were removed and the confidence of the natives restored, our commerce with Africa by means of the Quorra might be greatly increased. In the mean time, the late failure of Macgregor Laird and Oldfield will probably for a time damp the ardour of enterprise, and our commercial relations with this quarter of Africa may remain, for years to come, on nearly the same footing as before. (R. R. R.)

NIGHT, that part of the natural day during which the sun is underneath the horizon; or that time when it is dark or dusky. Night was originally divided by the Hebrews and other eastern nations into three parts or watches. But the Romans, and after them the Jews, divided the night into four parts or watches; the first of which began at sunset, and lasted till nine at night, according to our way of reckoning; the second lasted till midnight; the third extended to three in the morning; and the fourth ended at sunrise. The ancient Gauls and Germans divided their time, not by days, but by nights; the Anglo-Saxons followed the same method of reckoning; and the people of Iceland and the Arabs do the same at this day. The length and shortness of the night or of darkness is according to the season of the year and position of the place; and the causes of this variation are now well known. See Astronomy.

Night-Watching, a practice of very remote antiquity, and which belongs to the oldest regulations of police. As early as the time of Solomon we find mention made of it, and likewise in the Psalms of David. Sentinels were stationed in different places in Athens and in other cities of Greece, and they were kept to their duty by the visitations of the *thesmothetæ*. There were also *triumviri nocturni* in the city of Rome, as we learn from the commentaries of Henback on the police of the Romans. It appears, however, that the design of these institutions was rather the prevention of fires than the guarding against alarms or dangers by night, although in process of time attention was likewise paid to these objects. The apprehension of fires was the pretext of Augustus, when he wished to strengthen the night-watch for suppressing nocturnal commotions.

It does not appear that the practice of calling out the hours became established before the erection of city gates. It most probably had its rise in Germany; yet it would have been attended with advantage in ancient Rome, where there were no public clocks, nor any thing in private houses to indicate the hours. The various periods for soldiers to mount guard were determined by water-clocks; at the end of each hour they blew a horn, and by means of this signal every individual was apprised of the hour of the night. It seems evident, however, that these regulations were only attended to in time of war.

In the city of Paris, as at Rome, night-watching was established at the very commencement of the French monarchy; and De Lamare quotes the ordinances of Clothaire II. upon this subject, in the year 595. The citizens at first kept watch in rotation; but this practice was afterwards set aside, and, by the payment of a certain sum of money, a permanent watch was established. In the opinion of the learned and indefatigable Beckmann, the establishment of single watchmen, to call out the hours through the streets, was peculiar to Germany, and has only been copied by surrounding nations in more modern times. The elector John George, in 1588, appointed watchmen in Berlin; and Mabillon describes it as a practice peculiar to that country. Horns were made use of by watchmen in some places, and rattles in others; the former being most proper for villages, and the latter for cities.

The Chinese, as early as the ninth century, had watchmen posted upon their towers, who announced the hours both by day and by night, striking forcibly on a suspended board, which in that country is said to be in use to the present period; and at St Petersburg the watchmen employ a suspended plate of iron for a similar purpose. In this manner also Christians are assembled together in the Levant, for the purpose of attending divine service; and at an early period monks were thus awakened in monasteries to attend to the proper hours of prayer.

We find mention made of steeple-watchmen in Germany in the fourteenth century. In the year 1563, a church-steeple was erected in Leisnig, and an apartment built in it for a permanent watchman, who was obliged to proclaim the hours every time the clock struck. In the fifteenth century permanent watchmen were kept in many of the steeples at Ulm. The same thing was practised at Frankfort on the Mayne, at Oettingen, and in many other places; and Montaigne records his astonishment at finding a man on the steeple of Constance, who kept watch upon it continually, and who upon no pretext whatever was permitted to descend.

NIGIDIUS FIGULUS, Publius, one of the most learned men of ancient Rome, who flourished at the same time with Cicero. He wrote on various subjects, but his pieces appeared so refined and difficult that they were not regarded. He assisted Cicero, with great prudence, in defeating Catiline's conspiracy, and did him many services in the time of his adversity. He adhered to Pompey in opposition to Cæsar, which occasioned his exile; and he died in banishment. Cicero, who had always entertained the highest esteem for him, wrote to him a beautiful consolatory letter, the thirteenth of the fourth book of his *Epistolæ ad Familiares*.

NIGRITIA, Negroland, or Soudan, a general name for a considerable portion of the interior of Africa, some parts of which are as yet unknown, while some have been only recently explored by Clapperton, De Caille, Lander, and others. It comprises a great number of kingdoms, large and small, each of which will be found described under its own head. It appears to include all those countries which are situated between the sixth and seventeenth degrees of north latitude, and the eighth degree of west and thirty-second degree of east longitude. They are represented in maps as stretching along both sides of the Niger, and cluster around the great Lake Tshad or Shary. Still farther to the east, in the neighbourhood of the Bahr-el-Abiad or White River, one of the great branches of the Nile, is the country of the Shilluks, comprising Donga, Kordofan, Darfur, and Bergoo. The other chief states are Bambarra, Timbuctoo, and Kong, on the west; and Houssa, Burgou, Yarriba, Nouffe or Nyffe, Fundah, Bornou, Mandara, Begharmi, Kanem, and others, in the centre. These, although widely scattered, will, if taken as a whole, be found to be bounded on the north by the Sahara, on the east by Nubia, on the south by the Mountains of the Moon and Lower Guinea, and on the west by Senegambia. As thus defined, Nigritia is about 2500 miles from west to east, 500 from north to south, and has a superficial area of 1,250,000 square miles. A considerable portion of this territory is traversed by the Niger. In the centre is Lake Tshad, into which some large rivers empty themselves. For an account of this vast inland sea, and the surrounding country, the reader is referred to the article Bornou. There are several high ranges of mountains, such as those of Kong and Donga; some of the summits of the Mountains of the Moon are covered with perpetual snow. The nature of the climate, the productions and other particulars regarding this portion of Africa, will be found described in the article Africa.

NIJIBABAD, or Nijibgur, a town of Hindustan, in the province of Bareilly. It was built by a Rohilla chieftain, as a mart for the Cashmere trade, and is situated on the north branch of a small river which runs into the Ganges. Long. 78. 41. E. Lat. 29. 35. N.

NIKOLAJEW. See Nicolaiev.

NIKOLSK, a circle in the Russian province of Wologda, extending from east longitude 43. 45. to 47. 59., and from north latitude 58. 10. to 60. 25., being 13,156 square miles in extent. It is an elevated district, sloping both to the north and the south, and is the source of several rivers running in both directions. It is moderately productive, affording corn in average years sufficient for its scanty population, which does not exceed 65,000 persons. Nearly one half of the surface is covered with wood. The capital, of the same name, stands on the river Jug, and depends on the river navigation. Long. 45. 30. E. Lat. 59. 8. N.

NIKOLSKOI, a small town of Asiatic Russia, in the government of Oufa, on the Oural. It is eighty miles east-south-east of Orenburg.

NILCUND, a town of Northern Hindustan, and one of the celebrated places of Hindu pilgrimage, situated among the Himalaya Mountains, on the frontiers of Thibet. The cold at this place is intense; and at the end of June or beginning of August, when it is chiefly visited, the road is nearly impassable on account of the depth of snow. Avalanches are common on the road, and glaciers are seen in various parts. In the vicinity of this place there is a colossal statue of Gunneis; but the temple is dedicated to Mahadeva, one of whose numerous names is Nilcund, or Blue Throat. Long. 88. 50. E. Lat. 27. 51. N.

NILCUNDAH, a town of Hindustan, in the province of Hyderabad, forty-two miles south-east from Hyderabad, and the capital of a district of the same name. Long. 79. 15. E. Lat. 16. 55. N.

Nile.

NILE, a large and celebrated river of Africa, which flows through Nubia and Egypt. A general account of this celebrated stream has already been given in the article EGYPT, and more particularly of its course below Assouan, where it enters the long valley of Egypt; but important information having been obtained from recent travellers, especially regarding the upper courses of its two main forks, the Bahr-el-Abiad or White River, and the Bahr-el-Azrek or Blue River, it is necessary to give here some account of each of these branches.

The knowledge which the ancients possessed of the river Nile was much more perfect than that which they had acquired of the river Niger. Eratosthenes, the librarian of Alexandria, who flourished about 220 years before Christ, had a knowledge of the entire course of the river more correct than has been attained by moderns until a recent date;[1] and if his remarks be compared with those of Artemidorus, Strabo, and Ptolemy, it will be found that little information was ever added to that of Eratosthenes, regarding either the Nile or its branches, which form the great peninsula of Meroë. Eratosthenes distinguishes three great branches of the Nile; the first or most easterly being the Atbara or Tacazze; the second the Astapus or Bahr-el-Azrek; and the third the Nile proper, to which the two former are tributaries, namely, the Bahr-el-Abiad. He places lakes at the head of the Blue and White Rivers, and in so doing is followed by Ptolemy, who assigns an enormous extension southwards to the Blue River. In considering the White River the real Nile, he agrees with Herodotus, inasmuch as the historian states that the Nile came from the westward, and that the Automoli were at a distance above Meroë equal to that of Meroë above Elephantine; thus placing the Automoli on the White Nile, in the country now inhabited by the Denka. Under the Ptolemies the Greeks exploded the vulgar error which prevailed in the time of Herodotus, of supposing that the rivers of Western Africa flowed to the Nile. The opinion that lakes were situated at the sources of the two main branches of this great river having been found correct with regard to the Blue Nile, there is some reason for presuming that the Nile proper may have a similar origin; "and if," as Colonel Leake says, "we suppose Ptolemy to have placed the two lakes of the Nilus, or White River, twelve degrees to the south of their real position, as he is proved to have placed the Lake Coloe at the source of his Astapus, or the Abyssinian branch, it will follow that the lakes of the White River are about the latitude of five degrees north." This, of course, is merely conjectural; nor is it very philosophical to determine the latitude in which a river rises on the ground of a presumed error.

Our information regarding this great and unsolved problem of African geography, viz. the source of the Bahr-el-Abiad, is derived from three modern authorities, Browne, Linant, and Ibrahim Kashef, who headed a party sent out by the viceroy of Egypt in order to capture slaves in the distant regions of Soudan. Browne, it is well known, penetrated some degrees to the south of Darfur; and his inquiries went to prove that the sources of the river were situated about latitude seven degrees north and longitude twenty-seven degrees east, not in lakes, but in many streams flowing from the Gibel-el-Kumri, or Mountains of the Moon. It may be remarked, that this is precisely the name given by Ptolemy to the mountains at the source of the Nile; and Denham also found it attached to a part of the same great range farther to the westward. Linant, who travelled for the African Association in 1827, surveyed the course of the White Nile from the confluence of the Blue River to Aleïs, a direct distance of 132 geographical miles. But the most recent information is that of Ibrahim Kashef, who set out from Khartum, at the fork of the two great branches. This expedition, divided into two parties, marched for thirty-five days along both banks of the river. On the twelfth day they reached the first island of the Shilluks, traversed the territory of that people for fifteen days, and on the twenty-ninth day entered that of the Denka, from which they returned at the end of six days. The river was then shallow, and full of islands, six hours in breadth, and there were no mountains to be seen. "The latter part of the march," says Colonel Leake, "appears, from the description of Ibrahim, to have been in a direction nearly west; so that if the first island of the Shilluks, which they reached on the twelfth day, was not far from Aleïs, as Linant's journal gives reason to believe, the extreme point obtained by them was about twenty-nine degrees east longitude, and ten degrees north latitude. The result of the last expedition agrees with that of Browne's, inasmuch as it gives an easterly course to that part of the river which lies to the south of Darfur, and as it makes the sources of the river to fall to the south-westward of that kingdom, not farther northward than seven degrees north. It supports the opinion also that Browne's Donga is no other than the country of the Denka; that both the sources and mountains are more distant than Browne's information supposed; and still leaves the possibility, therefore, that Ptolemy was right in describing the river as originating in lakes. In fact, the enormous breadth attributed to the river by the Turkish slaving party, although it may be an exaggeration, and is certainly not to be reckoned by the usual allowance of the itinerary hour, leaves little doubt that the river, at the extreme point of their journey, was much broader than at its junction with the Blue Nile; and indicates, therefore, that its conformation is of an extraordinary kind, its origin being perhaps in a lake or lakes, which may be supplied

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[1] "Eratosthenes," says Colonel Leake, "was well informed on the course of the Nile above Egypt, and particularly as to the great south-western bend of Dongola, which was scarcely known to the moderns before the journey of Burckhardt into Nubia. It was from Eratosthenes that Strabo derived his information on the peninsula of Meroë, and it was probably from the same source that Artemidorus of Ephesus learnt that the city of Meroë was fifteen days distant from the sea. Eratosthenes described the island of Meroë as formed of two branches of the Nile, named Astaboras, now Atbara, and Astapus; but added, that the latter was sometimes called Astasobas, while the name Astapus was applied to another river rising in certain lakes to the south, meaning the White River. This agrees with Ptolemy, inasmuch as he clearly attaches the name Astapus to the Blue or Abyssinian Nile, and derives the Nilus, or proper Nile, that is to say, the White River, from lakes situated far to the south. On the other hand, Artemidorus, Strabo, and Pliny, followed those authorities alluded to by Eratosthenes, who gave the name Astapus to the White Nile, and that of Astasobas to the Blue River. The latter name may be accounted for by the discoveries of late travellers; from whom we learn, that on the right bank of the Bahr-el-Azrek, or Blue River, a little above the fork at Khartum, there are some ruins called Soba, apparently of the same age as those of Meroë; whence it would seem that Astasobas meant the river of Soba, and that the Ast, which enters into the composition of this and the two other names of the rivers of Meroë, implies *river*, having probably been introduced into that country by the Egyptian Greeks from Macedonia, where we find its elements, doubtless with the same import, in the names Astræus, Strymon, and perhaps also the modern Vistritza. Astapus, in fact, was the name of a Macedonian city (now called Istib), and not improbably of the river also upon which the town is situated. When the Blue Nile had generally assumed the appellation of Astasobas, that of Astapus may still have distinguished the united stream as far as the junction of the Astaboras, and may at length have become attached also to the White River above the fork, by a process which has often changed the names of rivers, especially when formed of two nearly equal branches. The Scamander of Troy is a remarkable instance. The Simoeis of Homer was the Scamander of the time of Strabo." (*Journal of the Geographical Society.*)

Nile.

by streams flowing from a distant range of mountains. The existence of lakes having a communication with the river only in time of high water is rendered highly probable by a passage in the journal of M. Linant, which states, that at the time of the inundation of the White River, an incredible quantity of fish is brought down towards Khartum by the current."[1] This is all the knowledge we possess regarding the source of the Nile proper, which, in spite of Bruce, still remains the same problem as it has ever been. Regarding the Egyptian expedition, Colonel Leake observes, "As a want of success alone caused the return of the Turkish slaving party, the natives constantly eluding their pursuit, it seems evident, that if geographical discovery, instead of man-stealing, had been their object, they might have explored the river much farther; and that it might consequently be in the power of the viceroy of Egypt to arrive at the mysterious sources, or to escort an European mission thither, if a motive sufficiently powerful should ever prompt him to assist in the attempt. In the mean time, a route by water, in the direction of the sources of the White Nile, is now afforded from the westward by means of the newly-discovered branch of the Quorra, called Shary, or Shadda, or Tshadda, which, being one mile and a half at its junction with the Quorra, is probably navigable for a great distance above the confluence."[2] There are great doubts, however, of the river Shary ever aiding in the discovery of the sources of the Nile, inasmuch as it probably has its origin in Lake Tshad, which is situated at least ten degrees west-north-west from the reputed sources of this great stream. Nor are our hopes that the problem will speedily be resolved at all raised by the Egyptian expedition; for the proceedings of the viceroy in hunting for slaves on the banks of the river has so exasperated the natives against the whites, that they will allow no opportunity of making reprisals upon them to escape. Such at least is the opinion of Mr Hoskins. "The source of the Nile could only," he thinks, "be discovered by an armed force; and even that method would present great difficulties. It would require a large army to subdue the great extent of country through which the Bahr-el-Abiad probably passes. Not only the chiefs, but the whole population, instead of any of them joining the standard of the invader, or furnishing him with provisions, would resolutely oppose him. Each man would fight with desperation for the preservation of his property, family, and liberty."[3] Besides, they thirst for vengeance on all Mahommedans and white men, and the circumstance of their being French or English would not avail. "They distinguish but two races, Pagan and Mahommedan, and two colours, black and white, their friends and enemies."

The voyage of M. Linant along the Bahr-el-Abiad having thrown considerable light on its character near to the point of junction, we shall present a brief analysis of his journal. From the mean of this traveller's astronomical observations, a small island placed just at the junction of the Bahr-el-Abiad with the Blue River is situated in latitude 15. 34. north, and longitude 32. 30. 58. east from Greenwich. On ascending the river, it was found in many places a mile and a half in width, and even then was far within its regular banks, which sometimes seemed about four miles apart, and were distinctly marked beyond a wide sandy beach destitute of any appearance of verdure. Even this is not the extreme breadth when the river is at its greatest height, as it then overflows the adjoining country to a considerable extent, especially to the westward, the eastern bank being the higher, although on both sides the general aspect of the country is flat. The farther banks are covered on the eastern side with wood of stunted growth, rooted chiefly in the sand; on the western side it is of larger size, growing on a better soil. The borders of the river were crowded with water game, such as wild geese, pelicans, swans, and the like. On being repeatedly sounded, the depth was always found to be from three to four fathoms. Farther up, the river was found to be somewhat narrower, the eastern shore to be lower, and both banks very richly wooded, with fine verdure clothing it close to the water's edge. Fish were taken in abundance by the natives, and hippopotamuses and crocodiles swarmed everywhere. Numerous islands were passed at intervals, some of them beautiful spots covered with tall trees of a splendid green, and thickly set with herbaceous plants. Multitudes of birds were found upon them; and from the trunks of trees bee-hives were easily procured. The Shilluks came from a distance for the sole purpose of obtaining this honey, and chasing the hippopotamuses. Aleïs was the highest point attained by M. Linant; and the following are the conclusions which he draws from the voyage: "The Bahr-el-Abiad is undoubtedly the principal of the two rivers which form by their junction the Nile of Egypt. It discharges a greater volume of water than the Bahr-el-Azrek; and although somewhat narrower immediately at the confluence than it is higher up, it is, even in this respect, equal to the Blue River. The colour of its waters is also that which characterises the conjunct stream in the dry season, the Bahr-el-Azrek being then of a greenish hue, while the Bahr-el-Abiad is always white, and as it were soapy, even during the inundations, when the Bahr-el-Azrek becomes reddish, from the nature of the detritus brought down by the Bahr-Toumat, which falls into it in the province of Fasuolo. And the Bahr-Mogren, or northernmost branch of the Nile, also brings down at this time a quantity of black earth, which influences the general colour."...."I have been unable," he continues, "to obtain any precise information as to the origin of the Bahr-Abiad, none but the Arabs called Corouns and the Wed Abrof pretending to know any thing of it. Hassan, the sheikh of Fasuolo, a well-informed man for his country, and who has travelled a great deal in the adjacent districts, gave me, however, some particulars, which induce me to believe that it cannot rise in a lower latitude than Fasuolo.[4] For the merchants who go directly west from that province into the country of the Negroes, and those who traverse the countries south of Darfur and Kordofan, along nearly the same road, and in the same parallel of latitude, as the Coroun Arabs, the Bagarras, the Wed Abrof, &c. all agree in saying that they pass no river west of Fasuolo, excepting the Toumat, and some slight streams which are nearly dry in the summer season; and that during the same season they have no water in their encampments along the skirts of the Ethiopian chain, which extends east and west a great distance, except what they find in the beds of torrents or among the rocks. When I asked them, also, why they did not rather follow the banks of the Bahr-Abiad, they always answered me that it passed a long way north of them; and that, beyond the Shilluks, it came directly from the west quarter.

"It is certain that, in the country of the Shilluks, there are other rivers which come from the west; and the following is a list of them in the order in which they are met in ascending the stream. First, the *Nid-el-Nil*, or Feast of the Nile, which passes close under the mountain called Guebel Dahir, or Mountain of the Round, so

[1] Journal of the Geographical Society, vol. ii. p. 26.

[2] Ibid.

[3] Hoskins' Travels in Ethiopia above the Second Cataract of the Nile, London, 1835, 4to.

[4] The journey of Ibrahim Kashef, already mentioned, is adverse to this opinion; and not less so the result of the oral information obtained from Mehemet Bey, by M. Ruppel, in Kordofan.

called because it is ascended spirally. It is covered with negro villages, is situated in the country of the Tagalla, and the river which passes to the south of it is said to flow from a great lake, to which I heard several names given, none of which I shall therefore recite. Several other rivers are reported to fall into it, the first called the Bahr-Soudan,[1] the second the Suar, the third the Hor-el-Karna, the fourth the Serat, and the fifth the Hor-el-Nahal, besides some others.

"The Sheikh Hassan of Fasuolo also told me, that south of the Shilluks the Bahr-Abiad is lost in some extensive lakes, which stretch away to the westward, and communicate with each other during the inundations, the intervening country being flat and marshy. And the remarks which I made on the stream agree well with this statement, neither gravel nor sand indicative of its being fed by torrents being found in it, and its shoals being all clay, proving that it does not come from mountains, but from a country of the same nature; or, at least, that if it does originate in mountains, it has a long subsequent course over a country of an opposite kind; whence its source cannot possibly be in the Mountains of the Moon, or, at least, in the place where they are marked in our maps. Besides all which, another remarkable fact seems to me to prove indubitably that it comes from a system of lakes; namely, the prodigious quantity of fish which arrive with the freshes at their first appearance; for these fish can only come from lakes, where they remain imprisoned when the waters are low, and escape when the inundation takes place."

At the point of its junction with the Bahr-el-Azrek the Bahr-el-Abiad is about eighteen hundred feet across; but, as we have already observed, it enlarges much a little above, its banks being frequently three or four miles apart, and in some places during the inundations the waters extend twenty-one miles from side to side. "It is said that they are specifically lighter," says M. Linant, "and more wholesome for use, than those of the Azrek; it is certain, at least, that the banks of the Abiad are much the more healthy." The cause of the comparative heaviness of the waters of the Azrek here mentioned, is no doubt to be attributed to the presence of earthy matters held in suspension by the waters, being part of the "detritus brought down by the Toumat," as described by M. Linant. But the statement regarding the superior salubrity of the waters of the Abiad is quite at variance with that of Mr Hoskins. "I have been assured by several Arab merchants, and also Turks," says he, "that the water of the river is less sweet than that of the Azrek, that the caravans stationed on what they call the island, between the two rivers, universally prefer the water of the latter. The Egyptians, therefore, are indebted to the Azrek for the singular sweetness of the waters of the Nile."[2] Mr Hoskins continues: "The Arabs' invariable description of the Bahr-el-Abiad is, that it has waves like the Red Sea, but the current is not powerful like that of the Blue River; that a boat would sail rapidly up, on account of the prevailing northerly winds, but it would be more difficult to descend. It is not improbable that the reason of the superior rapidity of the Blue River is its proximity to its source in the mountains, whilst the Bahr-el-Abiad may pass through immense districts, where the surface is more level and uniform."[3] The shores of the Abiad are in general very flat, especially on the western side; and the water is only deep towards the middle of the stream. On the western side the bank is composed a of deposit from the river, without any sand; but, on the opposite side, it is entirely of a yellowish sand, not brought down by the river, but by the south-east winds during the winter; and this being stopped by the river, forms hillocks, which give this side a greater elevation, and the descent from it to the water a greater declivity than on the opposite shore. Hence, also, the water on this side is a little deeper. The rise of the Bahr-el-Abiad is not perceptible till some time after that of the Bahr-el-Azrek. Below the junction the general aspect of the Nile has much more of the character of the Bahr-el-Azrek than that of the Bahr-el-Abiad, excepting in the colour of its waters during the dry season. In every respect it resembles the former as to the nature of its banks and adjoining scenery, its width, sinuous course, sand-banks, and the want of large shells, such as are only to be found on the shores of the Bahr-el-Abiad. Below, also, as well as along the banks of the Bahr-el-Azrek, there are comparatively few aquatic birds, whilst near the Bahr-el-Abiad they are innumerable. Lord Prudhoe thus compares the two rivers: "The banks of this river (the Bahr-el-Abiad) are low and flat, presenting a succession of grass lawn, and fine trees of the harrez (accacia). No scenery can be more unlike the Nile, whilst the Bahr-el-Azrek is its facsimile; the same high banks forming steppes from the annual inundations, bare of trees, but eminently fertile from the rich deposit of the river; whilst the Bahr-el-Abiad, stretching into wide lakes during the inundation, leaves the soil so sterile, that neither corn nor other crops, not even doorrah, can be grown when the waters subside; in lieu springs up grass, a production nearly unknown in Egypt. Here we saw a bird like the ibis, never seen on the Nile; it was black and white, with a curved beak, as represented in Egyptian sculpture. Many of the picus species were also flying about, with feathers of blue and red. The fish, too, of the Bahr-el-Abiad are peculiar to that river, and are not found in the Nile."[4] Such is a summary of the facts ascertained regarding the main branch or artery of the Nile.

The Bahr-el-Azrek, the other branch, flowing from the south-east, rises in Abyssinia, and joins the Bahr-el-Abiad under the parallel before specified. The province of Gojam, in which it rises, is very mountainous; and numerous streams which have their origin in this chain flow first eastward and form the great lake of Dembea, one of the most conspicuous features of Abyssinian geography. That which appears to be the largest of these issues from two fountains in Sacala, near Geesh, and after flowing into the lake, and quitting it on its eastern shore, sweeps in a semicircular direction round the provinces of Damot and Gojam, flowing first in a westerly course, and then taking its main bearing, which is north-north-west. The result of about forty observations of Bruce places these fountains in east longitude 36. 55. 30. and 10. 59. 25. north latitude. The mercury in the barometer stood at twenty-two inches, which indicates an altitude of more than two miles above the level of the sea. This river is considered in Abyssinia as the real Nile, and was so regarded by Bruce. All the Portuguese travellers and missionaries, from whom alone our early information is derived, were impressed with the same idea. It is not, therefore, wonderful that Bruce embarked on his arduous undertaking of penetrating to its sources under this impression; and that, after having placed his glory in the discovery, he should have admitted slowly and with cau-

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[1] In a former journey of M. Linant, he was informed by some Takrouri pilgrims from Dar Sille, that they travelled two months on the Bahr-Abiad before they arrived at Sennaar; that, before arriving at the Abiad, they followed the course of another river upwards; and that the Abiad had its rise in a country called Bahr-el-Lesse, from which some of the waters flow towards Marok, or Marocco, that is, to the north-west.

[2] Hoskins' Travels in Ethiopia, above the Second Cataract of the Nile.

[3] Ibid. p. 119.

[4] Journal of the Geographical Society, vol. v. part i. p. 41.

tion the observation of D'Anville, that the Bahr-el-Abiad, admitted to be the greater stream, even by the traveller himself, had in all respects the best title to be considered as the Nile of the ancients. But even granting that it is not, the admission will deduct little from the achievement of Bruce, whose journey to the fountains of Geesh, through wild and unexplored regions, must ever be regarded as one of the noblest instances of human daring, directed by judgment and science.

In its northerly course, the Bahr-el-Azrek, or Blue River, receives an accession of several considerable streams, amongst which are the Beto and Bahr-Toumat, flowing in on the western side, and the Dender, Rehat, and Rabat, which unite with it on the eastern side. The waters of the Bahr-Toumat are very considerable during the freshes, but at other times they are so dried up as not even to flow. When it begins to rise, however, it does so with such rapidity and violence as to carry every thing before it, the noise of its approach being thus heard at a considerable distance, and taken as a signal to escape from its banks with the utmost precipitation. At Sennaar, which is about one hundred miles above the junction of the Blue and White Rivers, Bruce describes the former as a "delightful river, above a mile broad, full to the very brim, but never overflowing. Everywhere on these banks are seen numerous herds of the most beautiful cattle of various kinds."..."The banks of the Nile about Sennaar resemble the pleasantest parts of Holland in the summer season; but soon after, when the rains cease, and the sun exerts his utmost influence, the dorra begins to ripen, the leaves to turn yellow and to rot, the lakes to putrefy, smell, and be full of vermin, all this beauty suddenly disappears." The principal tributary of the united streams of the Azrek and the Abiad, called variously the Tacazze, Atbara, Astaboras, Sittet, and Mugrum, falls into it in east longitude 34. 5. and in north latitude 17. 40. This river rises in Abyssinia, and flows through a great portion of it, draining all the high chains of mountains in its western part. The streams which combine to form the main river spread over a wide tract of country, and are very numerous, which is partly the cause of the Tacazze having so many names. Its principal tributaries are the Mareb and Mogreu (the Mareb of Bruce), the latter joining it not far from its confluence with the Nile. Here Bruce found it a quarter of a mile broad, and very deep, flowing through a parched, desert, and barren country, its banks having lost the beauty which clothed them whilst it flowed through Abyssinia. Mr Hoskins gives a more particular account of it. "Opposite to Unmatur is the junction of the Mugrum, the ancient Astaboras, with the Nile, which is comparatively clear at this season (March). I perceived also that the taste was different, and that it had a strong disagreeable smell."..."The width of the Mugrum, as the Astaboras is now called, from what I could learn, is, at the time of the rise, about a thousand feet. At this season they tell me it is almost stagnant. It swells many days earlier than the Bahr-el-Abiad or the Azrek; and I think the green colour that tinges the whole Nile for the first thirty or forty days after its rise may be attributed to the influx of the waters of this river. The chief province or district on its banks is called Atbara, evidently a corruption from the ancient name of the river, which is curious, as any analogy is rarely to be found between the modern and ancient names in this country."... "From the best information I have been able to obtain, there are seven days' journey from the mouth of the Mugrum to Goss Radjeb, the principal village on its banks: for the first two days the direction of this river is nearly east."[1] Mr Hoskins was also informed by some intelligent Arabs, that the Mugrum abounds much more than the Nile in hippopotamuses and crocodiles, and that the western bank is infested with lions. This river, along with the Nile, and its branch the Bahr-el-Azrek, encloses a tract of country called Meroë, which obtained from the ancients the name of Island. See MEROE.

After the junction of the Bahr-el-Azrek with the Bahr-el-Abiad, the Nile takes a very remarkable bend, which, as it appears on the map, cannot be better described than by saying that it resembles an irregular letter, S, the upper part, inclining to the left. This immense tortuosity extends from about the sixteenth to nearly the twenty-third degree of north latitude. To give a detailed account of the Nile and its banks during this long course, would only be to present an ever-recurring picture of the same objects. The width of the Nile varies exceedingly, being sometimes more than a mile, and at other times only about a quarter of a mile, in breadth. It is studded with innumerable islands, some of which are of very considerable size, and clothed with the richest vegetation. The banks of the Nile, also, are often picturesque and beautiful; and the portions of land which may be said to be enclosed by the bendings of the river contain a much greater extent of cultivated soil, and support a larger population, than any part of Lower Nubia. The whole of the country, however, which has been subjected to cultivation, can only be described as a long and narrow oasis, that has been rescued from the surrounding desolation by the river which traverses it. Dongola is the name of the territory most remarkable for its fertility and beauty. High granitic rocks enclose the green and cultivated valley of Jarjar, which flourishes in freshness and fertility in the bosom of the wildest waste. Immediately beyond it there is a pass called the Water's Mouth, particularly celebrated for the grandeur of its scenery. It is formed by a succession of huge detached masses of naked rock, and of large fragments scattered along the plain. Below is the large island of Argo, a spot of peculiar and striking fertility, forming in the bosom of the desert the most luxuriant natural garden. About ten miles above it is Maragga, El Ourde, or New Dongola, the last name having been given to it by the Mamelukes, who, during their temporary occupation of this country, made it their capital.

Before the Nile enters Egypt there occur those cataracts of the river so celebrated in antiquity, and so much exaggerated by some modern travellers. The first is situated about three miles above the island of Elephantine, in latitude 24° north. The beauty of this green spot on the waters strikes all travellers with admiration; by the natives it is termed the Island of Flowers, and travellers call it the Garden of the Tropics. It presents, indeed, within the space of a mile in length and a quarter of a mile in breadth, a verdure and fertility equal to the finest parts of Egypt. Whether or not the body of water of the Nile has, in the course of ages, worn or rather broken down the precipices over which the river once rushed, we cannot say; but this is certainly not at all probable. However, the thundering sound of the cataracts which was said to compel the inhabitants to remove to a distance from the deafening commotion, is no longer to be heard. It does not appear that there is at present any considerable fall, the highest not being above five feet in perpendicular descent. A picturesque and extraordinary scene, however, is produced by the Nile dashing through the wild confusion of granite rocks, with which its bed for several miles is thickly strewed. The rocky chain which stretches along either bank, presenting projections of every form, meet and cross in the middle of its course. The river, which above flows in calm majesty upwards of a mile in breadth, is here narrowed to

[1] Hoskins' Travels in Ethiopia above the Second Cataract of the Nile.

half that space; and its stream, forcing its way through the innumerable islets situated above, amidst, and below the cataract, boiling and foaming amidst a thousand rocks, presents a scene of peculiar grandeur and effect. The water in the different channels is tossed about in every direction, forming numberless little cascades; and the noise, resembling that of a tempestuous ocean beating on a rocky shore, is in winter and spring very formidable, being heard at the distance of three miles. There are six of these cataracts enumerated by travellers, besides some falls of inconsiderable size, although not surrounded by picturesque scenery. The most celebrated is the second cataract, situated at Wady Halfa, in latitude 21. 50. north. This cataract has also disappointed travellers, who expected to find it a mighty waterfall. Like the first, it is formed by a multitude of rocky islands, through which the Nile dashes amidst clouds of foam, and is whirled and tossed in perpetual eddies. The rocks consist of a species of black marble, not of granite, and the islets being covered with patches of verdure, and several of them being even inhabited, produce a picturesque effect, which relieves the aspect of desolation characteristic of the first. The fifth cataract is not to be compared to either the first or second for picturesque effect. "There are here no mountains or even hills," says Mr Hoskins, "and the fall at a little distance is scarcely perceptible. The sound is great, the rapids strong, and of such an extent, that at this season of the year (February) certainly no boat of any size could pass; when the Nile is high there would be little difficulty." The other cataracts do not require any particular notice. It is clear that they are rather what the Americans call rapids than what we are accustomed to associate with the name of cataract; a series of inconsiderable falls, remarkable rather for their number and the picturesque scenery adjacent thereto, than for any other circumstance or peculiarity.

The Nile enters Egypt at Assouan, near the site of the ancient Syene, in latitude 24° north. It follows nearly a northerly course, and below Cairo (latitude 30. 15. north) divides into two main arms, the Damietta or the eastern, and the Rosetta or western branch. A description of this, the most important part of the course of the Nile, has already been given at sufficient length in the article EGYPT, to which the reader is referred, as well as for an account of the inundation and other circumstances connected with this great river. As to the length of its course, the distance from the confluence of its two head branches to the sea has been estimated at 1500 miles, and from its highest sources at 2500 miles. (R. R. R.)

NILOMETER, an instrument used amongst the ancients to measure the height of the water of the river Nile during the periodical inundation. The word comes from Νειλος, *Nile*, and μετρον, *measure*. The Greeks more commonly called it Νειλοσκοπιον. The nilometer is said, by several Arabian writers, to have been first set up, for this purpose, by Joseph during his regency in Egypt; and the measure of it was sixteen cubits, this being the height of the increase of the Nile which was then necessary to the fruitfulness of Egypt.

From the measure of this column, Dr Cumberland deduces an argument, in order to prove that the Jewish and Egyptian cubits were of the same length. In the Royal Library of Paris there is an Arabic treatise on nilometers, entitled *Neil fi alnal al Nil*, in which are described all the overflowings of the Nile, from the first to the 875th year of the Hegira. Herodotus mentions a column which had been erected in a point of the island of Delta, to serve as a nilometer; and there is still one in a mosque at the same place.

The following is Bruce's account of the nilometer. "On the point of the island Rhode, between Geeza and Cairo, near the middle of the river, is a round tower enclosing a neat well or cistern lined with marble. The bottom of this well is on the same level with the bottom of the Nile, which has free access to it through a large opening like an embrasure. In the middle of the well rises a thin column of eight faces of blue and white marble, of which the foot is on the same plane with the bottom of the river. This pillar is divided into twenty peeks, of twenty-two inches each. Of these peeks the two lowermost are left, without any division, to stand for the quantity of sludge which the water deposits there. Two peeks are then divided, on the right hand, into twenty-four digits each; then on the left, four peeks are divided into twenty-four digits; then on the right, four, and on the left another four; again, four on the right, which completes the number of eighten peeks from the first division marked on the pillar. Thus the whole, marked and unmarked, amounts to something more than thirty-six feet English." (See Bruce's Travels (vol. iii.), and also the article EGYPT.)

NIMBUS, in *Antiquity*, a circle observed upon certain medals, or around the heads of some emperors, answering to the circles of light drawn round the images of saints.

NIMETULAHITES, a description of Turkish monks, so called from their founder Nimetulahi, famous for his doctrines and the austerity of his life.

NIMROD, the sixth son of Cush, and to all appearance much younger than any of his brothers, since Moses mentions the sons of Raamah, his fourth brother, before he speaks of him. What the sacred historian says of him is short; and yet he says more than of any other of the posterity of Noah, till he comes to Abraham. He tells us that "Nimrod began to be a mighty one in the earth;" that he was "a mighty hunter before the Lord," even to a proverb; and that "the beginning of his kingdom was Babel, and Erech, and Accad, and Calneh, in the land of Shinar."

From this account Nimrod is supposed to have been a man of extraordinary strength and valour. Some represent him as a giant; all consider him as a great warrior. It is generally thought that by the words "a mighty hunter," is to be understood that he was a great tyrant; but some of the rabbin interpret these words favourably, thinking that Nimrod was qualified by peculiar dexterity and strength for the chase, and that he offered to God the game which he caught; and several of the moderns are also of opinion that this passage is not to be understood of his tyrannical oppressions, or his hunting of men, but only of beasts. It must be owned that the phrase "before the Lord" may be taken in a favourable sense, and as a commendation of his good qualities; but the generality of expositors and commentators understand it otherwise.

Hunting must have been one of the most useful employments in the times immediately after the dispersion, when all countries were overrun with wild beasts, of which it was necessary that they should be cleared, to render them habitable; and therefore nothing seemed more proper to procure a man esteem and honour in those ages than his being an expert hunter. By that exercise, we are told, the ancient Persians qualified their kings for war and government; and hunting is still, in many countries, considered as part of a royal education.

There is nothing in the short history of Nimrod that carries the least air of reproach, excepting his name, which signifies a *rebel;* and that is the circumstance which seems to have occasioned the injurious opinions which have been entertained respecting him in all ages. Commentators, being in general prepossessed in favour of the opinion that the curse of Noah fell upon the posterity of Ham, and finding this prince stigmatised by such a name, have interpreted every passage relating to him to his disadvan-

Nimrod. tage. They represent him as a rebel against God, in persuading the descendants of Noah to disobey the divine command to disperse, and in setting them on to build the tower of Babel, with an impious design of scaling heaven. They brand him as an ambitious usurper and an insolent oppressor, and make him the author of the adoration of fire and idolatrous worship, as well as the first persecutor on the score of religion. On the other hand, some account him a virtuous prince, who, far from advising the building of Babel, left the country, and went into Assyria, because he would not give his consent to that extravagant project.

Nimrod is generally thought to have been the first king after the Deluge, though some authors, supposing a plantation or dispersion prior to that of Babel, have thought that there were kings in several countries before his time. Mizraim is conceived, by many who contend for the antiquity of the Egyptian monarchy, to have begun his reign much earlier than Nimrod; and others, from the uniformity of the languages which were spoken in Assyria, Babylonia, Syria, and Canaan, affirm that those countries must have been peopled before the confusion of tongues.

The four cities which Moses gave to Nimrod constituted a large kingdom in those early times, when few kings had more than one; only it must be observed, that possessions might at first have been large, and afterwards divided into several parcels; and Nimrod being the leader of a nation, we may suppose that his subjects were settled within those limits. Whether he became possessed of those cities by conquest or otherwise, does not appear. It is most probable he did not build Babel, all the posterity of Noah seeming to have been equally concerned in that affair; nor does it appear that he built the other three cities, although the founding of them, and many more, besides other works, are attributed to him by some authors. It may also seem a little strange that Nimrod should have been preferred to the regal dignity, and enjoyed the most cultivated part of the earth then known, rather than any other of the elder chiefs or heads of nations, even of the branch of Ham. Perhaps it was conferred on him for his dexterity in hunting, or it may be that he did not assume the title of king till after the death of his father Cush, who might have been settled there before him, and left him the sovereignty; but we incline to think that he seized Shinar from the descendants of Shem, driving out Ashur, who went from thence and founded Nineveh, and other cities in Assyria.

The Scripture does not inform us when Nimrod began his reign. Some date it before the dispersion; but such a conjecture does not seem to suit with the Mosaical history; for before the dispersion we read of no city but Babel, nor could there well be more whilst all mankind were yet in a body together. But when Nimrod assumed the regal title there seems to have been other cities, and this shows that he must have done so a considerable time after the dispersion. The learned writers of the Universal History place the beginning of his reign thirty years after that event, and in all likelihood it should be placed rather later than earlier.

Authors have taken a great deal of trouble to find Nimrod in profane history. Some have imagined him to be the same with Belus, the founder of the Babylonian empire; and others take him to be Ninus, the first Assyrian monarch. Some believe him to have been Evechous, the first Chaldæan king after the Deluge; and others perceive a great resemblance between him and Bacchus, both in actions and in name. Some of the Mahommedan writers suppose Nimrod to have been identical with Zohak, a Persian king of the first dynasty; whilst others contend for his being Kay Kaus, the second king of the second race; and some of the Jews say that he is the same with Amraphel, the king of Shinar, mentioned by Moses. But there is no certainty in these conjectures, nor have we any knowledge of his immediate successors.

Nimwegen ‖ Nineveh.

The Scripture mentions nothing respecting the death of Nimrod. Some of the rabbin pretend that he was slain by Esau, whom they make his contemporary. There is a tradition that he was killed by the fall of the tower of Babel, when that structure was overthrown by tempestuous winds. But others say, that when he led an army against Abraham, God sent a squadron of gnats, which destroyed most of them, and particularly Nimrod, whose brain was pierced by one of those insects.

NIMWEGEN, a city of the province of Guelderland, in the circle of the same name, in the Netherlands, comprehending six cantons, and 51,100 inhabitants. Of this circle Nimwegen is the capital. It stands on the left bank of the river Waal, over which there is an excellent flying bridge. It is situated on five hills, in a rich and pleasant district, and is well fortified. The streets are wide and clean, and the houses large and well built, and it has some agreeable promenades adjoining to it. In 1830, it contained 1900 houses, and 17,734 inhabitants, viz. 8402 males and 9332 females. Its chief trade consists in brewing, tanning, bleaching, distilling, and making Prussian blue, tobacco, snuff, and sealing-wax. It is celebrated for the peace concluded there in 1678 and 1679. Long. 5. 35. 21. E. Lat. 51. 51. 20. N.

NINE, the last of the radical numbers or characters, from the combination of which any definite number, however large, may be produced. "It is observed by arithmeticians," says Hume, "that the products of 9 compose always either 9 or some lesser products of 9, if you add together all the characters of which any of the former products is composed. Thus of 18, 27, 36, which are products of 9, you make nine, by adding 1 to 8, 2 to 7, 3 to 6. Thus 369 is a product also of 9; and if you add 3, 6, and 9, you make 18, a lesser product of 9." (See Hume's Dialogues on Natural Religion, p. 167, 168, 2d edit.)

NINE ISLANDS, a cluster of small islands in the Pacific Ocean, which were so called by Captain Carteret. Long. 154. 30. E. Lat. 4. 40. S.

NINEVEH, the capital city of Assyria, which was founded by Ashur the son of Shem (Gen. x. 11); or, as others read the text, by Nimrod the son of Cush. However this may have been, it must be owned that Nineveh was one of the largest and most ancient cities of the world. It is very difficult to assign exactly the time of its foundation; but it cannot have been long after the building of Babel. It was situated upon the banks of the Tigris; and in the time of the prophet Jonas, who was sent thither under Jeroboam II. king of Israel, and, as Calmet thinks, under the reign of Pul, father of Sardanapalus, king of Assyria, Nineveh was a very great city, its circuit being three days' journey (Jonah, iii. 3). Diodorus Siculus, who has given us the dimensions of this city, says that it was 480 stadia, or forty-seven miles, in circumference, and that it was surrounded with lofty walls and towers; the former being 200 feet in height, and so very broad that three chariots might drive along them abreast, and the latter 200 feet in height, and 1500 in number; and Strabo allows it to have been much greater than Babylon. Diodorus Siculus was, however, certainly mistaken in placing Nineveh on the Euphrates, since all historians as well as geographers who speak of that city, tell us in express terms that it was situated on the Tigris. At the time of Jonah's mission thither, it was so populous that it was reckoned to contain more than six score thousand persons who could not distinguish their right hand from their left (Jonah, iv. 11), which is generally explained of young children who had not yet attained to the use of reason; so that upon this principle it is computed that the inhabitants of Nineveh were then above 600,000 persons. Nineveh was taken by Arbaces and Belesis, in the year of the world 3257, under the reign of Sardanapalus, in the time of Ahaz, king of Judah, and about the epoch of the foundation of Rome. It was reduced a second time by Astyages and Nabopolassar, who took it from Chynaladanus, king of Assyria, in the year 3378. After this time, Nineveh no more recovered its former splendour. It was so entirely ruined in the time of Lucianus Samosatensis, who lived under the Emperor Hadrian, that no traces of it could be found, nor so much as the place where it stood. However, it was rebuilt under the Persians, and again destroyed by the Saracens about the seventh century.

NINGPO, a city of the first rank, and a great seaport, of China, in the province of Tchekiang, known to the early Portuguese navigators under the appellation of Siampoo. It is five miles in circumference, is situated in a fertile plain surrounded by hills, and is watered by numerous canals. It is much resorted to by the Chinese merchants of Fokien, as well as by those settled in Siam and Batavia, who repair thither for the purpose of buying the silks produced in its neighbourhood. It also carries on an extensive trade with Japan. Long. 120. 14. E. Lat. 29. 51. N.

NINIA, or NINIAN, commonly called *St Ninian*, a holy man amongst the ancient Britons. He resided at or near a place called by Ptolemy *Leucopibia*, and by Bede *Candida Casa;* but the English and Scotch called it *Whitehorne.* He is said to have been the first who converted the Scots and Picts to the Christian faith, which he effected during the reign of Theodosius the Younger. Bede informs us that he built a church dedicated to St Martin, in a style unknown to the Britons of that time; and adds, that during his time the Saxons held this province (*Gallovidia*, now *Galloway*), and that, as the converts to Christianity increased in consequence of the labours of this saint, an episcopal see was established there. Dr Henry, considering that few or none of the writings of the most ancient fathers of the British church are now extant, and that we can know but little of their personal history, and the extent of their erudition, gives a short account of some of them. Of St Ninian, he says that he was a Briton of noble birth and excellent genius. "After he had received as good an education at home as his own country could afford, he travelled for his further improvement, and spent several years at Rome, which was then the chief seat of learning as well as of empire. From thence he returned into Britain, and spent his life in preaching the gospel in the most uncultivated parts of it, with equal zeal and success."

NINIANS, ST, a large village in the parish of the same name in Scotland, about one mile and a quarter distant from Stirling. It has an ancient appearance, and consists of one large narrow street. Many of the houses are of considerable antiquity, and on them are carved the implements employed in the trade of the original proprietor. During the rebellion in 1745–46, the former church of St Ninians was used by the Highlanders as a powder magazine, and was accidentally blown up on their hurried departure for the north. The steeple, however, escaped unscathed from the general destruction, and now stands separated from the new church. Besides the parish church, there is in the village a relief chapel. Between St Ninians and the village of Bannockburn, which is situated at a short distance to the east, was fought the famous battle known by that name. The parish of St Ninians is also celebrated for being the scene of two other battles; that of Stirling, which was fought in 1297, when the Scottish army, under the command of Sir William Wallace, entirely defeated the English; and that of Sauchieburn, where the forces of James III. were defeated by those of his nobility, and the king put to death in a mill not far from the field, to which he had been carried. The inhabitants are chiefly employed in the manufacture of nails and leather; the former are considered as superior to those made in England. A considerable trade is also carried on in the manufacturing of carpets, tartan, and other stuffs of the same kind, five hundred of the inhabitants being thus employed. The population of the parish amounted in 1821 to 8274, and in 1831 to 9552.

NINON DE L'ENCLOS, a lady of a noble family, born at Paris in the year 1615, and famous for her wit and her gallantries. Her mother was a person of exemplary piety, but her father early inspired her with the love of pleasure. Having lost her parents at fourteen years of age, and finding herself mistress of her own actions, she resolved never to marry. She had an income of ten thousand livres a year; and, according to the lessons she had received from her father, drew up a plan of life and gallantry, which she pursued until her death. Never delicate with respect to the number, but always so in the choice, of her pleasures, she sacrificed nothing to interest, but loved only whilst her taste for it continued, and had amongst her admirers the greatest lords of the court. Notwithstanding the levity of her conduct, however, she had many virtues. She was constant in her friendships, faithful to what are called the laws of honour, of strict veracity, disinterested, and more particularly remarkable for perfect probity. Women of the most respectable characters were proud of the honour of having her as their friend; at her house there was an assemblage of every thing most agreeable in the city and the court; and mothers were extremely desirous of sending their sons to that school of politeness and good taste, that they might learn sentiments of honour and probity, and those other virtues which render men amiable in society. But Madame de Sevigné remarks with great justice in her letters, that this school was dangerous to religion and the Christian virtues, because Ninon made use of seducing maxims, capable of depriving the mind of those invaluable treasures. This singular woman was esteemed beautiful even in old age, and is said to have inspired the passion of love at eighty. She died at Paris in 1705.

NINUS, the first king of the Assyrians, is said to have been the son of Belus. It is added, that he enlarged Nineveh and Babylon; conquered Zoroaster, king of the Bactrians; married Semiramis of Ascalon; subdued almost all Asia; and died after a glorious reign of fifty-two years, about 1150 before Christ. But all these alleged facts are apocryphal.

NIO, an island of the Archipelago, situated between Naxi on the north, Armago on the east, Santerino on the south, and Sikino on the west, and about thirty-five miles in circumference. It is remarkable for nothing but Homer's tomb, which it is pretended is in this island, where he is said to have died in his passage from Samos to Athens. Long. 25. 35. E. Lat. 36. 43. N.

NIOBE, according to the fictions of the ancient poets, was the daughter of Tantalus, and the wife of Amphion, king of Thebes, by whom she had seven sons and as many daughters. Having become so proud of her fertility and high birth, as to prefer herself before Latona, and to slight the sacrifices offered up by the Theban matrons to that goddess, Apollo and Diana, the children of Latona, resented this contempt; the former slew the male children, and the latter the female, upon which Niobe was struck dumb with grief, and remained without sensation. Cicero was of opinion, that on this account the poets feigned that she had been turned into stone.

NIONS, an arrondissement of the department of the Dome, in France, 470 square miles in extent. It comprehends four cantons, divided into seventy-five communes, and containing a population of 33,800 persons. The capital is the city of the same name situated on the river Aigues. It contains only 2850 inhabitants, who carry on some trade in silks, woollens, and leather.

NIORT, an arrondissement of the department of the Two Sèvres, in France, extending over 594 square miles. It contains ten cantons, which are divided into ninety-four communes, and inhabited by 87,500 persons. The capital, both of the arrondissement and the department, is the city of the same name situated on the navigable river Sévres-Mortaise. It has a fine Gothic church, an athenæum, with a library of 12,000 volumes, a chemical laboratory, a botanic garden, and a cabinet of physical preparations. It contains 1980 houses, and 15,500 inhabitants, who find occupation in making woollen goods, and in preparing leather, chiefly for gloves, of which about 20,000 dozen pairs are annually produced. It suffered much in consequence of the insurrection in La Vendée during the Revolution, but has in a great degree recovered since the return of tranquillity. Long. 0. 34. 32. W. Lat. 46. 20. 8. N.

NIPHON, an extensive island in the east of Asia, forming by much the largest portion of the empire of Japan. It is of an irregular form, with numerous windings, and is 800 or 900 miles in length, but in average breadth it does not exceed 100. The spiritual and temporal capitals of Jedo and Macao are situated in this island; but for a particular account of these the reader is referred to the article JAPAN.

NIPPERS, in the manège, are four teeth in the fore part of a horse's mouth, two in the upper and two in the lower jaw. The horse puts them forth between the second and third year.

NIRGUA, a town of Colombia, in South America. It is situated upon a low mountain ridge, which extends from the Sierra Nevada of Merida to the north-east, separating the head waters of the Apure and Orinoco from the streams which fall into the Carribbean Sea, or the Lake of Maracaybo. The climate is very hot, and not at all salubrious, which, with other causes, has contributed to reduce the city; the latter is now in decay, and contains only about three thousand inhabitants. Depons describes the people as robust and strong, but lazy, and addicted to every species of vice. They consist wholly of Zamboes, that is, a mixed race, composed of negroes and Indians. There are some gold mines situated in the valley of Nirgua; and silver is likewise found in the vicinity. Nirgua is in lat. 10° north, and long. 71° 10′ west of Paris, about forty-eight leagues west of Caraccas.

NIRMUL, a town of Hindustan, in the province of Berar, and district of Nandere, belonging to the nizam. It is situated four miles north of the river Godavery. Long. 79. 33. E. Lat. 19. 18. N.

NISAN, a month of the Hebrews, corresponding to our March, but which sometimes takes from February or April, according to the course of the moon. It was the first month of the sacred year at the period of the exod from Egypt (Exod. xii. 2), and it was the seventh month of the civil year. By Moses it is called Abib. The name Nisan is only found since the time of Ezra, and the return from the captivity of Babylon. On the first day of this month the Jews fasted for the death of the children of Aaron. On the tenth day was celebrated a fast for the death of Miriam the sister of Moses, and every one provided himself with a lamb for the passover. On this day the Israelites passed over Jordan under the conduct of Joshua. On the fourteenth day, in the evening, they sacrificed the paschal lamb; and the day following, being the fifteenth, was celebrated as the solemn passover. On the sixteenth they offered a sheaf of the ears of barley as the first fruits of the harvest of that year. The twenty-first, being the octave of the passover, was solemnized with particular ceremonies. On the twenty-sixth the Jews fasted in memory of the death of Joshua; and this day they commenced their prayers to obtain the rains of the spring. On the twenty-ninth they called to mind the fall of the walls of Jericho.

NISHAPOUR, an ancient city of Persia, formerly one of the richest and greatest in the extensive province of Khorassan, is situated in a fine plain, about eighty miles in length by fifty or sixty in breadth, well studded with fine villages, and plentiful gardens full of trees, which bear fruits of the highest flavour. According to Frazer, in his Narrative of a Journey into Khorassan (p. 432), it was a rich and pleasing scene, and by far the most populous and cultivated tract he had seen in Persia. This plain was formerly irrigated by 12,000 aqueducts, which have now been suffered to fall into decay, and are destitute of water. The city has suffered deeply from the wars which have at different times desolated Persia. It was destroyed by Alexander the Great, and was, after the lapse of many years, rebuilt by Sapor I., whose statue was to be seen at Nishapour until it was overturned and broken in pieces by the Arabs. About the middle of the twelfth century Nishapour was taken by the Tartars, and so completely ruined by those barbarians, that the inhabitants, on their return, could not distinguish the site of their own houses. Hakani the Persian poet, who flourished at this period, describes, in the most affecting terms, the overthrow of this great city. It recovered from this ruin, however, and once more regained its former splendour, when it was again taken and pillaged by the savage Genghis Khan, and reduced to desolation. The inhabitants amount at present to about 15,000, who occupy only a single quarter of the city, the ruins of which are said to cover a circuit of twenty-five miles. The most delicious fruits are here found in the greatest abundance. The city is at present subject to the dominion of the king of Persia, and has nine districts dependent on it, each of which contains about ten walled villages. It is thirty miles south of Meshed, and 230 north-east of Herat.

NISHEGOROD, a province of the Russian empire, in Europe. It takes its name from the capital city, and extends in north latitude from 54. 31. to 56. 4., and in east longitude from 41. 37. to 46. 27., containing 21,142 square miles. It is divided into eleven circles, which comprehend thirteen cities and 5380 villages, which latter are formed into 762 parishes, each having a Greek church. The inhabitants are estimated at 1,500,000, the great mass of whom adhere to the religion of the Greek church; but there are many tribes of Tartars scattered throughout the province, who, like their ancestors, remain heathens. The whole province is undulating, with no elevations that are more than 400 feet above the level of the sea. The soil is generally sandy, but much of it is compounded of portions of clay and marl, and other earths, so that where cultivation is conducted with any degree of skill and attention, the produce is considerable. In corn the crops commonly yield one fourth more than the consumption requires. The chief grains are rye and buck-wheat; but there is much wheat grown, and the increase on appropriate soils is said to be tenfold the seed. A great quantity both of hemp and flax is raised, and all the common garden vegetables and fruits. The woods extend along the banks of the great rivers, and afford abundance of fuel, and of timber for the construction of houses and ships. The province is admirably watered, the chief river being the Wolga, which receives the waters of the Oka, the Kutma, the Kirsentz, the Sura, the Wetluga, and the Alatyr, all of which are navigable to the main stream. It is a manufacturing district, producing abundance of matting, hempen and flaxen cloths, soap and candles, iron in bars and in common implements, leather, corn, spirits, and some glass. These, with live cattle, raw hides, and wood, form the principal articles of the export trade, which is chiefly carried on by the Wolga and its tributary streams. The city of Nishegorod, the capital, is 830 miles from St Petersburg, being in latitude 56. 19. 43. north, and in longitude 46. 23. 5. east. It stands at the junction of the Oka with the Wolga, in a picturesque situation, between hills; and it is the centre of the trade, as well as of the government of its province, and the seat of a Greek bishop. It contains 1826 houses, mostly of wood, and 12,300 inhabitants, who chiefly subsist by manufactures and trade, which connect them with the Persians, Siberians, Turks, and Tartars, who resort in great crowds, especially to a fair which lasts from the 29th of June to the end of July annually.

NISIBIN, a village of Persia, in the pachalik of Bagdad, which was in ancient times the celebrated fortress of Nisibis, and, from the time of Lucullus until the decline of the empire, was regarded by the Romans as the firmest bulwark of the East. This city was taken by Lucullus, from Tigranes, king of Armenia. It was three times besieged by the king of Persia, who, by the treaty of Dura, at last obtained quiet possession of the fortress, which had successfully resisted the utmost efforts of his arms. Nisibis, in the hands of the Persians, braved the attacks of successive emperors, and baffled the military talents of Belisarius; until at last, after the final overthrow of the house of Artaxerxes, it was reduced, along with the other cities of Mesopotamia, under the power of the Saracens. The foundations of the walls, and several detached towers, as well as part of the church built in honour of St James, who was formerly bishop of Nisibis, are still standing. They overlook the little but rapid river Mygdonius, and are approached by a small Roman bridge of twelve arches. To the west there is a view of the lofty mountains of Sinjar, covered with verdure; and the prospect to the north and east is bounded by the ridge of Mount Masius, forming a vast amphitheatre, at the extremity of which, in a clear day, may be descried the distant turrets of Merdin. The adjacent country has a pleasing appearance, the numberless villages which overspread the plains being built wholly on conical hills, bearing a striking resemblance to our feudal castles. Grecian and Roman coins, with other antiquities, are frequently dug out of the ruins. The black tents of the Kurds now cover the greater part of the city. Nisibin is seventy-eight miles south-east of Diarbekir, and seventy north-west of Mosul.

NISI PRIUS, in *Law*, a judicial writ which lies in cases where, the jury being impanelled and returned before the justices of the bank, one of the parties requests to have such a writ for the ease of the country, that the trial may take place before the justices in the same county on their coming thither. The purport of a writ of *nisi prius* is, that the sheriff is thereby commanded to bring to Westminster the men impanelled, at a certain day, before the justices, *nisi prius justiciarii domini regis ad assisas capiendas venerint.*

NISMES, an arrondissement of the department of the Gard, in France, 635 square miles in extent. It comprehends eleven cantons, divided into seventy-five communes, and contains 122,450 inhabitants. The capital is the city of the same name, which is situated in an extensive and fruitful plain, bounded by two parallel hills. It has a labyrinth of narrow and ill-built streets; but the suburbs are much more regular, and contain the best edifices, together with some open places, and pleasing promenades. Nismes contains many remains of antiquity, especially a Roman amphitheatre capable of seating 20,000 spectators. It has a cathedral, ten Catholic and five reformed churches, with 4800 houses, and 42,800 inhabitants, of whom about one eighth are Protestants. It contains an academy, with a library of 30,000 volumes. Its industry consists in the manufacture of silks, hosiery, cottons, lace, ribbons, and especially brandy. Nismes was the birthplace of the celebrated Protestant preacher Saurin, and of the poet Florian.

NISROCH, a god of the Assyrians. Sennacherib was killed by two of his sons whilst he was paying his adorations to the god Nisroch in his temple (2 Kings, xix. 37); but it is not known who this god Nisroch was. The Septuagint calls him Mesrach, and Josephus denominates him Araskes, while the Hebrew of Tobit, published by Munster, calls him Dagon. The Jews have a strange notion concerning this deity, whom they fancy to have been a plank of Noah's ark. Some think that the word signifies a dove; and others understand by it an eagle, which has given occasion to an opinion, that Belus, from whom the Assyrian kings pretended to be derived, was worshipped by them under the form of an eagle, and called Nisroch.

NITHSDALE, NITHISDALE, or *Niddisdale*, a district of Dumfriesshire, in Scotland, lying to the westward of Annandale. It is a large and mountainous tract, deriving its name from the river Nid or Nith, which rises on the borders of Ayrshire, and, running by Sanquhar and Dumfries, discharges itself into the Solway Frith.

NITOCRIS, the mother of Belshazzar, whose father was Evilmerodach, and his grandfather Nebuchadnezzar. She was a woman of extraordinary abilities, who took upon herself the burden of all public affairs, and, whilst her son followed his pleasures, did all that could be done by human prudence to sustain the tottering empire. She perfected the works which Nebuchadnezzar had begun for the defence of Babylon; raised strong fortifications on the side of the river; and caused a wonderful tunnel to be constructed under it, leading from the old to the new palace. She likewise built a bridge across the Euphrates, and accomplished several other works, which were afterwards ascribed to Nebuchadnezzar. Philostrates, in describing this bridge, tells us that it was built by a queen, who was a native of Media; and hence we may conclude that this illustrious princess was by birth a Mede.

NIVELLE DE LA CHAUSSEE (*Peter Claude*), a comic poet, was born in Paris, and acquired great reputation by inventing a new kind of entertainment, called the Weeping Comedy. Instead of imitating Aristophanes, Terence, Molière, and the other celebrated comic poets who had preceded him; and instead of exciting laughter by painting the different ridiculous characters, or giving strokes of humour and absurdities in conduct; he applied himself to represent the weaknesses of the heart, and to touch and soften it. In this manner he wrote five comedies: 1. La Fausse Antipathie; 2. Le Préjugé à la Mode; 3. Melanide; 4. Amour pour Amour; and, 5. L'Ecole des Mères. He was received into the French Academy in 1736, and died at Paris in 1754, at the age of sixty-three. He also wrote a tragedy entitled Maximianus; and an epistle to Clio, an ingenious didactic poem.

NIVELLES, a circle of the province of South Brabant, in the Netherlands, comprehending six cantons, divided into 115 communes, and containing 87,480 inhabitants. The chief place is the city of the same name situated on the river Thienne. It contains 750 houses, and 7000 inhabitants, whose chief employment consists in making lace, cambrics, and other linen goods, and in growing hemp, flax, and hops, in the surrounding fields. Long. 4. 10. E. Lat. 50. 35. N.

NIZAMPATAM, a town of the south of India, in the province of the Northern Circars. It is situated at the mouth of the Krishna River, forty miles west-south-west from Masulipatam. It carries on a considerable coasting trade. Long. 80. 35. E. Lat. 15. 56. N.

NIZZA DELLA PAGLIA, a city of the province of Aqui, in Piedmont, standing on the river Belbo, where the Nizza falls into it. It is a poor place, surrounded with walls, containing a few splendid houses, five monasteries, and 5156 inhabitants, who chiefly subsist by spinning silk and cultivating vineyards.

NO, or NO-AMMON, a considerable city of Egypt, dedicated to Ammon or Jupiter. The Septuagint translate the name in Ezekiel, *Diospolis*, or the City of Jupiter. Bochart takes it to be *Thebes* in Egypt, which, according to Strabo and Ptolemy, was called *Diospolis*. Jerome, after the Chaldaic paraphrast Jonathan, supposes it to be Alexandria, named thus by way of anticipation; or an ancient city of that name which is supposed to have stood on the spot where Alexandria was afterwards built.

NOACOTE, an inconsiderable town of Northern Hindustan, situated in a fruitful valley of the same name. Though small, it contains some of the largest and best looking houses in Nepaul, also a celebrated Hindu temple dedicated to Bhavany. Its situation is of importance, as commanding the only entrance into this quarter from Upper as well as Lower Thibet, and standing close to Mount Dhyboon, by which the Chinese army was obliged to descend in 1792, when they invaded Nepaul. The valley of Noacote, in which the town is situated, is six miles in length by one mile and a quarter in breadth. Long. 85. 30. E. Lat. 27. 43. N.

NOAH, NOACH, or NOE, the son of Lamech, was born in the year of the world 1056. Amidst the general corruption into which all mankind had at this time fallen, Noah alone was found to be just and perfect in his generation, walking with God. This extraordinary person having therefore found favour in the sight of Heaven, the Almighty, seeing that all flesh had corrupted their ways, told Noah that he was resolved to destroy mankind from the face of the earth by a flood of waters; and not them alone, but all the beasts of the earth, and every creeping thing, as well as the fowls of the air. The Lord therefore directed Noah, as a means of preserving himself and his family (for he had three sons, Shem, Ham, and Japheth, who were all married before the Flood), to build an ark or vessel of a certain form and size fitted to that end, and which might besides accommodate such numbers of animals of all sorts, that were liable to perish in the Flood, as would be sufficient to preserve the several species, and again to replenish the earth.

In the year of the world 1656, being the six hundredth of his age, Noah, by God's appointment, entered the ark, together with his wife, his three sons, their wives, and all the animals which God had caused to come to him; and being all entered, and the door of the ark being shut down from the outside, the waters of the Deluge began to fall upon the earth, and increased in such a manner that they were fifteen cubits above the tops of the highest mountains, and continued thus upon the earth for 150 days; so that whatever had life upon the earth, or in the air, was destroyed, except such as were with Noah in the ark. But the Lord remembering Noah, sent a wind upon the earth, which caused the waters to subside; so that upon the seventeenth day of the seventh month the ark rested on the mountains of Ararat; and Noah having uncovered the roof of the ark, and observing that the earth was dry, he received orders from the Lord to come out of it, with all the animals that were therein. This he did in the six hundred and first year of his age, on the 27th day of the second month. See the article DELUGE.

Then Noah offered as a burnt sacrifice to the Lord one of all the pure animals that were in the ark; and the Lord accepted his sacrifice, and said to him that he would no more pour out his curse upon the whole earth, nor any more destroy all the animals, as he had now done. He gave Noah power over all the brute creation, and permitted him to eat of them, as well as of the herbs and fruits of the earth; excepting only the blood of animals, the use of which God did not allow him. He bade him increase and multiply, made a covenant with him, and engaged no more to send an universal deluge upon the earth; and as a memorial of his promise, he set his bow in the clouds, to be as a pledge of the covenant which he had made with Noah.

Noah, being an husbandman, began now to cultivate the vine; and having made wine and drank thereof, he unwarily became intoxicated, and falling asleep in his tent, happened to uncover himself in an indecent posture. Ham, the father of Canaan, having observed him in this condition, made sport with his father, and acquainted his two brothers, who were without, of the exposure of the patriarch But they, instead of making it a matter of sport, turned away from it, and going backwards, they covered their father's nakedness, by throwing a mantle over him. Noah awaking, and knowing what Ham had done, said that Canaan the son of Ham should be accursed, that he should be a slave of slaves in respect of his brethren. It is thought he had a mind to spare the person of his son Ham, for fear the curse might light upon the other children of Ham, who had had no part in this action. He cursed Canaan by a spirit of prophecy, because the Canaanites, his descendants, were afterwards to be rooted out by the Israelites. Noah added, Let the Lord, the God of Shem, be blessed, and let Canaan be the servant of Shem. And he was so in effect, in the person of the Canaanites subdued by the Hebrews. Lastly, Noah said, Let God extend the possession of Japheth; let Japheth dwell in the tents of Shem, and let Canaan be his servant. This prophecy had its accomplishment, when the Grecians, and afterwards the Romans, being descended from Japheth, made a conquest of Asia, which formed the portion of Shem.*

But Noah lived yet after the Deluge three hundred and fifty years; and the whole duration of his life having been nine hundred and fifty years, he died in the year of the world 2006. He left three sons, Shem, Ham, and Japheth, of whom mention is made under their several names; and, according to the common opinion, he divided the whole world amongst them, in order that it might be repeopled. To Shem he gave Asia, to Ham Africa, and to Japheth Europe. Some will have it, that, besides these three sons, he had several others. The spurious Berosus assigns him thirty, called Titans, from the name of their mother. It is also pretended that the Teutons or Germans are derived from a son of Noah called Thuiscon. Methodius likewise mentions Jonithus or Jonicus, a pretended son of Noah.

St Peter calls Noah a preacher of righteousness, because before the Deluge he was incessantly preaching and declaring to men, not only by his discourses, but by his blameless life, and by the building of the ark, in which he was employed six score years, that the wrath of God was ready to descend upon them. But his preaching had no effect, since, when the Deluge came, it found mankind plunged in all their former enormities.

Several learned men have observed, that the Heathens confounded Saturn, Deucalion, Ogyges, the god Cœlus or Uranus, Janus, Proteus, Prometheus, and others, with Noah. The wife of Noah is called Noriah by the Gnostics; and the fable of Deucalion and his wife Pyrrha is manifestly a corruption of the history of Noah.

NOANAGUR, a very large town, and the capital of a district of the same name, surrounded by a stone wall of no great strength, with round towers and a ditch. It is situated on the river Nagne, which is supposed by the natives to possess some qualities peculiarly favourable for the dyeing of cloths, for which, as well as the manufacture thereof, this place is celebrated. The chief of Noanagur coins money in his own name. His subjects are addicted to piracy; but in the year 1808 he entered into a treaty with the British to refrain from this practice, and not to plunder any ships which might be driven on their coast by distress. Long. 70. 15. E. Lat. 22. 20. N.

NOB, a sacerdotal city of the tribe of Benjamin or Ephraim. St Jerome says, that in his time it was entirely destroyed, and that the ruins of it might be seen not far from Diospolis. When David was driven away by Saul, he went to Nob, and asking the high priest Ahimelech for some provisions and arms, the priest gave him the shewbread which had lately been taken off the holy table, and the sword of Goliath. Saul being informed of this by Doeg, caused all the priests of Nob to be slain, and the city to be destroyed. (1 Sam. xxi. xxii.)

NOBA, a small island in the Eastern Seas, near the western coast of Aroo. Long. 135. 13. E. Lat. 5. 5. S.

NOBAH, a city beyond Jordan, which took the name of Nobah from an Israelite of this name who had conquered it. Gideon pursued the Midianites as far as this city. Eusebius informs us, that there is a desolate place of this name about eight miles from Heshbon, towards the south; but this could not be the Nobah now mentioned, because the latter was much farther to the north.

NOBILIARY, a book containing the history of the noble families of a nation or province.

NOBILITY, in general, signifies dignity, grandeur, or greatness, but more particularly antiquity of family, joined with riches. In the common acceptation of the word, it means that quality or dignity which raises a man above the rank of a commoner.

Whether that equality of rank and condition which has sometimes been contended for would be more agreeable to the order of nature, or more conducive to the happiness and prosperity of mankind, may be made a question; but it is one, we apprehend, which cannot receive different answers from men capable of reflecting without prejudice and partiality. A state of perfect equality can subsist only amongst beings possessing equal talents and virtues; but such beings are not human. Were all mankind under the constant influence of the laws of virtue, a distinction of ranks would be unnecessary; but in that case civil government itself would likewise be unnecessary, because men would have attained all that perfection to which it is the object of civil government as well as of religion to guide them, and every man would then be a law unto himself. But whilst, in so many breasts, the selfish passions predominate over those which are social, violence must be restrained by authority; and there can be no authority without a distinction of ranks, such as may influence public opinion.

It is observed by Hume, that government is founded solely on opinion; and that this opinion is of two kinds, opinion of interest and opinion of right. When a people are persuaded that it is their interest to support the government under which they live, that government must necessarily be stable. But amongst the worthless and unthinking part of the community, this persuasion has seldom any place. All men, however, have a notion of rights—of a right to property, and a right to power; and when the majority of a nation considers a certain order of men as having a right to that eminence in which they are placed, this opinion, call it prejudice or what you will, contributes much to the peace and happiness of civil society.

"The distinction of rank and honours," says Blackstone, "is necessary in every well-governed state, in order to reward such as are eminent for their services to the public, in a manner the most desirable to individuals, and yet without burden to the community; exciting thereby an ambitious yet laudable ardour, and generous emulation, in others. And emulation, or virtuous ambition, is a spring of action which, however dangerous or invidious in a mere republic or under a despotic sway, will certainly be attended with good effects under a free monarchy; where, without destroying its existence, its excesses may be continually restrained by that superior power from which all honour is derived. Such a spirit, when nationally diffused, gives life and vigour to the community; it sets all the wheels of government in motion, which, under a wise regulator, may be directed to any beneficial purpose; and thereby every individual may be made subservient to the public good, while he principally means to promote his own particular views. A body of nobility is also more peculiarly necessary in our mixed and compounded constitution, in order to support the rights of both the crown and the people, by forming a barrier to withstand the encroachments of both. It creates and preserves that gradual scale of dignity which proceeds from the peasant to the prince; rising like a pyramid from a broad foundation, and diminishing to a point as it rises. It is this ascending and contracting proportion that adds stability to any government; for when the departure is sudden from one extreme to another, we may pronounce that state to be precarious."

The origin of nobility in Europe is a subject involved in considerable obscurity. In this place we shall only consider the manner in which nobility may be created in this country, with the incidents attending it.

1. The right of peerage seems to have been originally territorial, that is, annexed to lands, honours, castles, manors, and the like, the proprietors and possessors of which were, in right of those estates, allowed to be peers of the realm, and were summoned to parliament to do suit and service to their sovereign; and, when the land was alienated, the dignity passed along with it as an appendage. Thus in England the bishops still sit in the House of Lords in right of succession to certain ancient baronies annexed, or supposed to be annexed, to their episcopal lands; and thus in 11 Henry VI. the possession of the castle of Arundel was adjudged to confer an earldom on its possessor. But afterwards, when alienations became frequent, the dignity of the peerage was confined to the lineage of the party ennobled, and, instead of territorial, became personal. Actual proof of a tenure by barony became no longer necessary to constitute a lord of parliament; but the record of the writ of summons to him or his ancestors was admitted as a sufficient evidence of the tenure.

Peers of Great Britain are now created either by writ or by patent; for those who claim by prescription must suppose either a writ or patent to have been issued or granted to their ancestors, though by length of time it has been lost. The creation by writ or the king's letter is a summons to attend the House of Peers, by the style and title of that barony which the king is pleased to confer; that by patent is a royal grant to a subject of any dignity and degree of peerage. The creation by writ is the more ancient way; but a man is not ennobled thereby, unless he actually take his seat in the House of Lords; and some are of opinion that there must be at least two writs of summons, and a sitting in two distinct parliaments, to establish a hereditary barony; and therefore the most usual, because the surest way, is to grant the dignity by patent, which endures to a man and his heirs according to the limitation thereof, although he himself should never make use of it. Yet it is frequent to call up the eldest son of a peer to the House of Lords by writ of summons, in the name of his father's barony, because in that case there is no danger of his children's losing the nobility in the event of his never taking his seat; for they will succeed to their grandfather. Creation by writ has also one advantage over that by patent. A person created by writ holds the dignity to himself and his heirs, without any words to that purport in the writ; but in letters-patent there must be words to direct the inheritance, otherwise the dignity endures only to the grantee for life. For a man or woman may be created noble for their own lives, and the dignity not descend to their heirs at all, or descend only to some particular heirs; as where a peerage is limited to a man and the heirs male of his body by Elizabeth his present lady, and not to such heirs by any former or future wife.

Nobility.

2. Let us next take a view of a few of the principal incidents attending the nobility, exclusive of their capacity as members of parliament, and as hereditary counsellors of the crown. And here it may be observed, that in criminal cases a nobleman must be tried by his peers. The great are always obnoxious to popular envy. Were they to be judged by the people, they might be in danger from the prejudices of their judges; and would moreover be deprived of the privilege of the meanest subjects, that of being tried by their equals, which is secured to all the realm by Magna Charta (c. 29). It is said that this does not extend to bishops, who, though they are lords of parliament, and sit there by virtue of the baronies which they hold *jure ecclesiæ*, yet are not ennobled in blood, and consequently not peers with the nobility. As to peeresses, no provision was made for their trial when accused of treason or felony, till after Eleanor duchess of Gloucester, wife to the lord protector, had been accused of treason, and found guilty of witchcraft, in an ecclesiastical synod, through the intrigues of Cardinal Beaufort. This very extraordinary trial gave occasion to a special statute (20 Hen. II. c. 9), which enacted, that peeresses, either in their own right or by marriage, should be tried before the same judicators as peers of the realm. If a woman, noble in her own right, marries a commoner, she still remains noble, and must be tried by her peers; but if she be only noble by marriage, then by a second marriage with a commoner she loses her dignity; for as by marriage it is gained, so by marriage it is also lost. Yet if a duchess-dowager marries a baron, she continues a duchess still; for all the nobility are *pares*, and therefore it is no degradation. A peer, or peeress, either in her own right or by marriage, cannot be arrested in civil cases; and they have likewise many peculiar privileges annexed to their peerage in the course of judicial proceedings. A peer sitting in judgment gives not his verdict upon oath, like an ordinary juryman, but upon his honour; he answers also to bills in chancery upon his honour, and not upon his oath; but when he is examined as a witness either in civil or criminal cases, he must be sworn; for the respect which the law shows to the honour of a peer does not extend so far as to overturn a settled maxim, that *in judicio non creditur nisi juratis*. The honour of peers is however so highly tendered by the law, that it is much more penal to spread false reports concerning them, and certain other great officers of the realm, than concerning other men; scandal against them being called by the peculiar name of *scandalum magnatum*, and subjected to peculiar punishment by different ancient statutes.

A peer cannot lose his nobility except by death or attainder, although there was an instance, in the reign of Edward IV., of the degradation of George Neville, duke of Bedford, by act of parliament, on account of his poverty, which rendered him unable to support his dignity. But this is a singular instance, which, by having happened, serves to show the power of parliament; and, by having happened only once, proves how tender the parliament has been in exerting so high a power. It has been said, indeed, that if a baron waste his estate, so that he be not able to support the degree, the king may degrade him; but it is expressly held by later authorities, that a peer cannot be degraded except by act of parliament.

Matthæus observes, that nobility amongst the Romans was quite a different thing from what it is amongst us. The nobles, amongst the Romans, were either those raised to the magistracy, or descended from magistrates; there was no such thing as nobility by patent.

Bartoli states, that doctors, after they have held a professor's chair in an university for twenty years, become noble, and are entitled to all the rights of counts. But this claim is not admitted at court; though Bartoli's sentiments be backed by those of several other authors, particularly Chassanæus in his *Consuetudines Burgundiæ*, Boyer *sur la Coutume de Berry*, and *Faber C. de Dig. Def.* 9. The last, however, restrains Bartoli's rule to doctors in law, and princes' physicians.

NOBLE, *Nobilis*, a person who has any privilege which raises him above a commoner or peasant, either by birth, by office, or by patent from his prince. The word comes from the Latin *nobilis*, formed from the ancient *noscibilis*, distinguishable or remarkable.

In England the word *noble* is of a narrower import than in other countries, being confined to persons above the degree of knights; whereas abroad it comprehends not only knights, but what we simply call *gentlemen*. The nobles of England are also called *pares regni*, as being *nobilitatis pares*, though *gradu impares*.

Nobles, amongst the Romans, were such as had the *jus imaginum*, or the right of using the pictures or statues of their ancestors; a right which was allowed only to those whose ancestors had borne some curule office, that is, had been curule ædile, censor, prætor, or consul. For a long time none but the *patricii* were the *nobiles*, because no person except those holding that superior rank could bear any curule office; and hence in Livy, Sallust, and other authors, the word *nobilitas* is used to signify the patrician order, and is hence opposed to *plebs*. To render the true meaning of *nobiles* still clearer, let it be observed, that the Roman people were divided into *nobiles*, *novi*, and *ignobiles*. The *nobiles* were those who had the pictures or statues of their ancestors; the *novi* were such as had only their own; and the *ignobiles* were such as had neither. The Roman nobility, by way of distinction, wore a half moon upon their shoes, especially those of patrician rank.

The nobility of Greece were called Ευπατριδαι, as being descended from those old heroic ancestors so famous in history. Such were the *Praxiergidæ*, *Etrobutidæ*, *Alcmæonidæ*, and others, all of whom had many privileges annexed to their quality, and, amongst the rest, that they wore grasshoppers in their hair as a badge of nobility.

Noble, a money of account, containing six shillings and eightpence. The noble was anciently a real coin struck in the reign of Edward III., and then called the *penny of gold*; but it was afterwards called a *rose-noble*, from its being stamped with a rose. It was current at six shillings and eightpence.

NOCERA DE PAGANI, a city of the kingdom of Naples, in the province Principato Citeriore. It stands at the foot of a hill near the river Sarno, and is the see of a bishop, containing a cathedral, several parish churches and monasteries, with 6790 inhabitants.

NOCTAMBULI, Noctambulones, or *Night-walkers*, a term of equal import with *somnambuli*, applied to persons who have a habit of rising and walking about in their sleep. The word is compounded of the Latin *nox*, night, and *ambulo*, I walk. See Somnambula.

NOCTILUCA, a species of phosphorus, so called because it shines in the dark without any light being thrown upon it.

NOCTURNAL, something relating to the night, in contradistinction to diurnal.

Nocturnal, *Nocturlabium*, an instrument chiefly used at sea, in order to take the altitude or depression of some stars about the pole, and thereby to find the latitude and hour of the night. Some nocturnals are hemispheres or planispheres, on the plane of the equinoctial. Those commonly used amongst seamen are two; the one adapted to the polar star, and the first of the guards of the Little Bear; the other to the pole star, and the pointers of the Great Bear.

This instrument consists of two circular plates applied to each other. The greater, which has a handle to hold the instrument by, is about two inches and a half in diameter, and is divided into twelve parts, agreeing to the twelve months; and each month is subdivided into every fifth day, so that the middle of the handle corresponds to that day of the year in which the star observed has the same right ascension with the sun. If the instrument be fitted for two stars, the handle is made moveable. The upper left circle is divided into twenty-four equal parts for the twenty-four hours of the day, and each hour is subdivided into quarters. These twenty-four hours are noted by twenty-four teeth to be told in the night. Those at the hour of twelve are distinguished by their length. In the centre of the two circular plates is adjusted a long index, moveable upon the upper plate; and the three pieces, viz. the two circles and index, are joined by a rivet which is pierced in the centre with a hole, through which the star is to be observed.

To use the nocturnal, turn the upper plate till the long tooth marked twelve be against the day of the month upon the under plate; then, bringing the instrument near the eye, suspend it by the handle with the plane nearly parallel to the equinoctial, and viewing the pole star through the hole of the centre, turn the index about, till, by the edge coming from the centre, you see the bright star or guard of the Little Bear (if the instrument be fitted to that star); then the tooth of the upper circle, under the edge of the index, is at the hour of the night on the edge of the hour circle, which may be known without a light, by counting the teeth from the longest, which is for the hour twelve.

NOD, or the *Land of Nod*. It was to this country that Cain withdrew after the murder of his brother. The Septuagint, as well as Josephus, read *Naid* instead of *Nod*, and have taken it for the name of a place. It is not easy to ascertain what country this was, unless perhaps it was the country of Nyse or Nysea, towards Hyrcania. St Jerome and the Chaldaic interpreters have taken the word Nod in the sense of an appellative for vagabond or fugitive; "He dwelt a fugitive in the land."

NODATED HYPERBOLA, a name given by Sir Isaac Newton to a kind of hyperbola, which by turning round, decussates or crosses itself.

NODES, in *Astronomy*, the two points where the orbit of a planet intersects the ecliptic. See ASTRONOMY.

NODUS, or NODE, in *Dialling*, a certain point or pole in the gnomon of a dial, by the shadow or light of which either the hour of the day in dials without furniture, or the parallels of the sun's declination, and his place in the ecliptic in dials with furniture, are shown. See DIALLING.

NOESA BARON, an island in the Eastern Seas, near the south coast of Java, about twenty-five miles in circumference. Long. 113. 20. E. Lat. 8. 20. S.

NOESA CAMBAZ, or PULO CANNIBAZ, an island in the Eastern Seas, near the southern coast of Java, about forty-five miles in circumference. Long. 109. E. Lat. 7. 42. S.

NOESA LAOER, a small island in the Eastern Seas, near the southern coast of Ceram. Long. 129. 0. E. Lat. 3. 34. S.

NOESA NESSING, a small island in the Eastern Seas, near the northern coast of Timor. Long. 126. 30. E. Lat. 8. 9. S.

NOETIANS, in *Ecclesiastical History*, Christian heretics in the third century, followers of Noetius, a philosopher of Ephesus, who pretended that he was another Moses sent by God, and that his brother was a new Aaron. His heresy consisted in affirming that there is but one person in the Godhead; that the Word and the Holy Spirit were but external denominations given to God in consequence of different operations; and that, as Creator, he is called *Father*, as Incarnate, *Son*, and as descending on the apostles, *Holy Ghost*.

NOGARCOTE, a town of Northern Hindustan, in the kingdom of Nepaul. It is now tributary to the Chinese, by whom it was taken in 1792. It is sixty miles east from Catamandoo. Long. 86. 5. E. Lat. 28. 2. N.

NOGENT LE ROTROU, an arrondissement of the department of the Eure and Loire, in France. It extends over 402 square miles, is divided into four cantons and sixty-five communes, and contains 42,500 inhabitants. The capital is the city of the same name, situated on the river Huine, which here unites with the Arcisse, and both form a remarkable cascade. It is a well-built place, in a fruitful district, and contains 1250 houses, with 6850 inhabitants, who are employed in weaving linens and serges. Long. 0. 37. E. Lat. 48. 20. N.

NOGENT SUR SEINE, an arrondissement in the department of the Aube, in France. It is 365 square miles in extent, contains 30,600 inhabitants, and is divided into four cantons, which are subdivided into sixty-nine communes. The capital is the city of the same name, situated on the left bank of the Seine. It contains 750 houses, and 3400 inhabitants, who make some cotton goods and hosiery, but whose chief trade consists in sending wood to Paris. Long. 3. 55. E. Lat. 48. 5. N.

NOIRMOUTIER, an island belonging to the department of La Vendée, and arrondissement of Les Sables d'Olonne, in France. It forms a canton, and is on the western side of the island of Bouin. It is about fifteen miles in length, and about four in breadth. Its situation is low, and, to prevent the sea from overflowing it, it is surrounded with powerful dikes. The soil is very rich within the enclosure, and produces heavy crops of corn. Beyond the dikes are marshes, which afford abundance of salt formed by natural evaporation. The inhabitants are 5700, and many of them expert seamen, occupied in the fisheries. The chief town gives its name to the island; it contains 1600 inhabitants, and has a harbour capable of admitting vessels of fifty or sixty tons. Long. 2. 21. W. Lat. 47. 1. N.

NOJA, a city on a river of the same name, in the province of Basilicata, in the kingdom of Naples. It suffered a loss of one fourth of its population in 1816, from an epidemic disease. The inhabitants now amount to 5400, who cultivate much cotton.

NOLA, a city of the kingdom of Naples, in the province of Terra di Lavoro. It is the site of an ancient Roman city, buried under the effects of an eruption of Mount Vesuvius, and is altogether a gloomy place, with a cathedral and thirteen other churches, containing 8950 inhabitants.

NOLLE PROSEQUI is where a plaintiff in an action does not declare in a reasonable time, in which case it is usual for the defendant's attorney to enter a rule for the plaintiff to declare, after which a *non prosequitur* may be entered. A *nolle prosequi* is esteemed a voluntary confession that the plaintiff has no cause of action; and therefore if a plaintiff enters his *nolle prosequi*, he may be amerced; but if an informer cause the same to be entered, the defendant may have costs.

NOLLEKENS, JOSEPH, a distinguished English sculptor, was born at London, on the 11th of August 1737. His father, a native of Antwerp, was a painter by profession, and is mentioned by Horace Walpole, under the name of Old Nollekens, as an artist of some repute. He died whilst Joseph was still very young, and his widow having married again soon after his decease, the education of the youthful sculptor was much neglected. In his thirteenth year we find him in the studio of Scheemakers, where he exhibited his passion for his art by drawing and modelling early and late with the utmost assiduity. As his powers expanded, he became a candidate for the prizes offered to rising genius by the Society of Arts, which in the year 1759 gave him a premium of fifteen guineas for a group of figures in clay; in 1760 they presented him with thirty

Nollekens. guineas for a bas-relief, and during the same year they gave him ten guineas more for a model in clay of a dancing faun. He now began to attract considerable notice, as much on account of his quiet, mild, inoffensive appearance, as from the unquestionable cleverness of his productions; and Garrick, proverbially an observer of character, set down Joseph as a rising man of genius. No artist was ever greeted with even the comparatively limited applause which the works of this young sculptor elicited, without longing to visit those miracles of genius which are treasured in the land where art, like one of the native deities, sprang forth at once; nor was Nollekens an exception to the rule. In his twenty-third year, we find him in Rome, friendless, and nearly reduced to want, but enthusiastically pursuing his vocation. He modelled and carved in stone a bas-relief which brought him ten guineas in England; and in the following year, his group of Timoclea before Alexander, in marble, was honoured by the Society of Arts with a premium of fifty guineas. This success placed him above absolute dependence; and he was now noticed by the artists in Rome, particularly Barry, and also by some English visitors, amongst whom were Garrick and Sterne. The great English actor recognised him one day in the Vatican, invited him to breakfast next morning, and ended by sitting to him for his bust, for the model of which Garrick paid twelve guineas to the artist. Sterne likewise sat to him at Rome; and the bust of the wit, which is in terra-cotta, is considered as an admirable likeness. To the last hour of his life Nollekens alluded to it with pleasure. "Dance," he used to say, "made my picture with my hand leaning on Sterne's head; he was right."

But Nollekens, if he did not discover, profited by other means of enriching himself, which were less laborious than cutting out beautiful forms from the marble. In 1761, fragments of antique sculpture were more frequently to be met with in Rome and its vicinity; and legs, arms, heads, and other members of the body, strewed about like wrecks, when collected and put together with skill, were sold at very considerable prices. Joseph being sprung of a race of picture-makers and sellers, his spirit for bargaining was probably never surpassed; and this, with his proficiency as a sculptor, enabled him not only to collect the best fragments at the most reasonable prices, but to supply deficiencies, and put them together to the greatest advantage. That this proved a most successful speculation, the following anecdote, amongst many of the same kind which might be related, will sufficiently show. A loose head of Minerva, which even Englishmen would not purchase, lay on the shelf of a regular dealer in such articles, where it attracted the attention of Nollekens. It happened that the body of the same, or some other heathen goddess, was brought to light, and purchased by him for fifty guineas. A consultation was held with his brother dealer; the head and trunk were found of similar proportions, and the sculptor undertook to unite them as neatly as if they had both been chiseled from the same block of marble. This he accomplished, and Minerva stood forth restored. "It was sold," says his biographer and executor, Mr Smith, "for the enormous sum of one thousand guineas, and is now at Newly, in Yorkshire." A few speculations equally profitable would soon have raised the artist to affluence. He was, besides, liberally patronised by his countrymen who annually migrated to the capital of Italy, and for whom he executed many considerable works in marble, of which Mercury and Venus chiding Cupid are considered as the best. For all his productions he received immediate and liberal payment. Early misfortunes had made Nollekens acquainted with privation. Being an economist from necessity, he became frugal from habit; and this continued to influence his conduct when the necessity for parsimony no longer existed. He lived at Rome in a very humble manner, and after ten years of profitable study, he returned to London comparatively rich. Nollekens.

Nollekens was now prepared to commence business upon his own account, and accordingly he took a lease of extensive premises in Mortimer Street. The busts of Sterne and Garrick had spread his fame in his native country, and he no sooner opened his doors than orders came in abundance. In 1771 he was admitted an associate of the Royal Academy, and in the following year was elected a member, much to the satisfaction of George III., who soon afterwards honoured the artist by sitting for his bust. The history of a man of genius is that of his works; and the few events which diversify his career, besides the successive appearance of his productions, serve but little to relieve its characteristic monotony. Amongst these the choice of a partner for life is probably the most important. Nollekens was not unfortunate in this respect. The lady of his choice was the friend of Samuel Johnson, and, if report may in aught be credited, the great critic was not insensible to her charms. Mrs Nollekens was endowed with no small share of that parsimonious spirit which her husband is said to have been so abundantly gifted withal, and was quite of his opinion as to one material point, namely, that the accumulation of wealth is not the least of our terrestrial pleasures. Nollekens was fully aware that his strength lay in busts; and as this line of art was an exceedingly profitable one, it may readily be supposed that his time and talents were principally devoted to it. Amongst his sitters were the great, the beautiful, and the titled of the land; and his profits were commensurate with the condition of his employers. He also found leisure to work out, slowly and with much care, marble groups and statues, amongst which may be mentioned those of Bacchus, Venus taking off her sandal, Hope leaning on an urn, Juno, Pætus and Arria, and Cupid and Psyche. His portraits were excellent, and there was generally a gentleness in the expression, and a gracefulness in the handling, which never failed to please. The likenesses of his busts were acknowledged by all, and the prettiness of the statues could not fail to be as generally admitted. But original vigour was wanting. He was one in whom the merely imitative faculty infinitely surpassed the imaginative. He could transfer to the marble, with the most perfect certainty and success, the features of a sitter; but he could not impart to the works of his hands that ideal beauty which etherealzes the subject, and is equal to the creation of a whole dynasty of gods and goddesses. As his strength lay in the sculpture of busts, so he pursued it with unparalleled success, and his studio became a fashionable lounge for those who reckoned their heads of sufficient importance to their friends or their country to have them modelled and cut in marble.

Towards his sitters, even the most exalted personages, he conducted himself with exceeding homeliness. Nollekens was all his life an unsophisticated child of nature, and his manners would no doubt appear very uncouth, perhaps vulgar, to that class of people who were accustomed to the dignified respect of Reynolds, or have since admired the courtly attentions of Lawrence. He had too much knowledge of human nature, however, not in his own blunt manner to employ flattery for the purpose of securing steadiness or a good position in the sitter.

The want of imagination Nollekens partially supplied by a diligent study of the antique; and hence, whilst every statue surpassed its predecessor in delicacy of workmanship, the artist only attained eminence by incessant labour. He was not one of those prodigies who reach their zenith as it were at the first flight. He was probably as little indebted to nature as most men who have attained greatness; but never-failing zeal for his profession, joined to unflinching industry, would have raised to distinction a less promising artist than Nollekens. During a period of ten years, from 1776 to 1786, he exhibited sixteen busts, five statues, and four groups, some of which were not in marble. The statues were those of Juno, Diana, Adonis, Cupid, and Mercury, in which he followed the beaten track, without attempting any thing new. Amongst his monumental effigies may be mentioned that which commemorated the three commanders who fell in Rodney's great battle of the 12th April 1782. This being one of the government statues, the choice of the sculptor rested with the Royal Academy, and, after a fair competition, the design of Nollekens was that approved of. The monument is of large dimensions, and has a look of magnificence; but it is deficient in nature and sentiment, which can only be compensated to a limited extent by fine marble and fine workmanship. Another of his monumental works commemorates a lovely woman who died in childbed, and in it Religion is by her side holding up her finger to heaven. This production has always been greatly admired for the simplicity and beauty of the design, and for the skilful manner in which it is executed. The love of the nation for busts seemed to increase with the supply, and Nollekens found ample employment for his talents. Between 1786 and 1800, he sent some dozen of these to the exhibition; but during that period he is well known to have executed thrice as many more, his prices increasing with his fame, from one hundred to one hundred and fifty guineas. From his Venuses and other statues of that description, we pass on to those productions which were more suitable to the genius of the artist. The ten years which followed 1800 were the busiest in the life of Nollekens; for although he was between sixty and seventy years of age, he continued to work with the same diligence and skill as in his youth. Upwards of fifty busts proceeded from his chisel, besides nearly a score of groups and statues. Amongst the former were the far-famed heads of Pitt and Fox, those of the Prince of Wales, afterwards George IV., Dr Burney, the Marquis of Stafford, the Duke of Bedford, and others. Of the twenty statues and groups, the statue of Pitt for Cambridge attracted most attention at the time. The Venus anointing herself, however, was the favourite work of Nollekens, though it is deficient both in originality and in propriety of action. The workmanship of the statue, however, is very fine.

By temperance and perpetual equanimity of mind, Nollekens, although declined into the vale of years, still laboured as assiduously as ever. From 1810 till 1816, the last year of his exertions, he modelled some thirty busts, not a few of which are ranked amongst the most valuable of his works. The principal heads are those of the Duke of York, Lords Castlereagh, Aberdeen, Erskine, Egremont, Liverpool; Canning, Perceval, Benjamin West, and Thomas Coutts the banker. In 1817 Nollekens lost his wife, but being above eighty years of age, he was beyond that period of life when grief can be very acutely felt; and it is even hinted by some of his biographers, that his natural parsimoniousness, not being kept alive by the example of his still more penurious lady, assumed a milder form. He became in every respect more liberal, and presents to the needy members of his profession, with donations to benevolent institutions connected with art, were occurrences not so uncommon as formerly. For several years he lingered in that state of listlessness in which the mind shares the decay of the body, and dissolution, being preceded only by a gradual and almost imperceptible sinking of the vital powers, when it does take place, may be said to be felt rather than observed. Nollekens departed this life on the 23d of April 1823, leaving a fortune of some two hundred thousand pounds. This appears a vast sum indeed to have been accumulated by an artist; but several other distinguished ornaments of the profession have been even more liberally rewarded than he was, and have only left less because they were either less industrious or less economical.

With regard to the merits of Nollekens as an artist, little need be added to what has already been said. It was in bust sculpture that he most excelled; and here the chief attraction is ease and simplicity, whilst the chief defect is a want of dignity and sentiment. "There is little dignity," says his biographer, "but much truth; sometimes mechanic vigour, never exaggeration. It cannot be denied, however, that his vigour is often tame, his serenity languid; that his women are often beautiful without sentiment, and that in his men he is apt to miss that manly breadth of character which is the token of all that is great and noble." There is, however, some cant and affectation in all this. It is not the business of an artist to look into the soul or read the characters of men and women. He has to do only with material forms, and all that can be expected of him is to interpret faithfully, and fix permanently, that natural expression by which each individual is distinguished. Mr Nollekens, like Crabbe, was "nature's sternest painter, but her best." Adhering to strict truth, rather than dealing in sentiment, he did not feel himself at liberty to misinterpret the signs of natural expression according to the rank of his sitter, and give the intellectual grandeur of a forehead like Burke's to the features of Castlereagh because he was a lord, or to those of Mr Coutts because he was a banker and could afford to pay for it. (R. R. R.)

Nollet.

NOLLET, Jean Antoine, regius professor of physics in the College of Navarre, and member of the Academy of Sciences at Paris, of the Royal Society of London, of the Institution of Bologna, and of the Academy of Sciences of Erfurt, was born at Pimbré, in the diocese of Noyon, on the 17th of November 1700. He was the son of respectable but not wealthy parents, who, to make up for the want of riches, determined to give their son a good education. They sent him to the College of Clermont in Beauvoisin, and afterwards to Beauvais, there to finish his introductory studies. The progress which he made in the different classes decided them to send him to study philosophy at Paris; and having intended him for the clerical order, they considered the strictness and purity of his morals, together with his unwearied application to study, as sufficient proofs of his vocation. The young Nollet yielded without reluctance to the wishes of his parents. As soon as he was capable of showing an inclination for any thing, he had discovered a taste for physics; but this had not become his ruling passion; and he therefore sacrificed it to the study of scholastic divinity, to which he wholly dedicated himself during the time of his probation in 1728. No sooner had he been invested with the deaconship, than he solicited and obtained a license to preach. This new occupation, however, did not make him entirely lose sight of those studies which had first engaged his attention, and insensibly began to occupy a greater portion of his time, which was now more equally divided between theology and the sciences. The latter, however, prevailed; and thenceforth he entered upon the study of physics with an ardour which was only increased by that kind of privation to which he had been long subject. He was received into the Society of Arts established at Paris under the patronage of the Count de Clermont. In 1730, the Abbé Nollet was engaged in a work in conjunction with Reaumur and Dufay of the Academy of Sciences. In 1734 he went to London in company with MM. Dufay, Duhamel, and Jussieu; and his merit procured him a place in the Royal Society without any solicitation. Two years afterwards, he went to Holland, where he formed an intimate connection with Desaguliers, s'Gravesande, and Musschenbroeck. On his return to Paris, he resumed the course of experimental physics which he had begun in 1735, and which he continued till 1760. These courses of physics first suggested the idea of giving particular courses in other branches of science, such as in chemistry, anatomy, and

Nomades ‖ Nomarcha.

natural history. In 1738, the Count de Maurepas prevailed on Cardinal Fleury to establish a public class for experimental physics; and the Abbé Nollet was appointed the first professor. In the beginning of the year 1739, he was admitted a member of the Royal Academy of Sciences; and in the month of April following, the king of Sardinia, intending to establish a professorship of physics at Turin, invited the Abbé Nollet to visit his dominions. In 1744, he was honoured with an invitation to Versailles, to instruct the dauphin in experimental philosophy; and the king and royal family were often present at his lectures. The young prince, until the period of his death, showed marks of the strongest attachment to this ingenious philosopher; and even prevailed upon him to go and pay court to a man in power whose patronage might be of service to him. The Abbé Nollet accordingly waited upon the placeman, and made him a present of his works. "I never read any works of that kind," said the patron coldly, at the same time casting a look at the volumes before him. "Sir," replied the Abbé, "will you allow them to remain in your antichamber? *There*, perhaps, there may be found men of genius who will read them with pleasure." In the month of April 1749, he made a tour in Italy, having been sent thither for the purpose of making observations. At Turin, Venice, and Bologna, the Abbé Nollet appeared as a deputy from the philosophers of the rest of Europe. During his short stay in Italy, the wonders of electricity were not the only object of his researches; every part of physics, the arts, and agriculture, came equally under his notice. Upon his return through Turin, the king of Sardinia, sensible of his merit, offered him the order of St Maurice, which, however, he did not think proper to accept without his sovereign's permission. In 1753 the king instituted a class of experimental philosophy in the Royal College of Navarre, and appointed the Abbé Nollet professor. In 1757 he received from the king a brevet appointing him preceptor in physics and natural history to the *Enfans de la France*. In the month of August the same year he was appointed professor of experimental philosophy in the school of artillery, which was at that time established at La Fère. In the month of November following, he was admitted as a pensionary of the Royal Academy of Sciences. M. de Cremillo, director-general of artillery and fortification, having founded a class of experimental philosophy at Mezières in 1761, the Abbé Nollet was appointed professor. This celebrated and laborious philosopher, who rendered the most important services to physics by the discoveries with which he has enriched every branch of this science, but particularly electricity, died at Paris on the 25th of April 1770, aged seventy. His works are, 1. Several Papers inserted in the Memoirs of the Academy of Sciences, amongst which one on the Hearing of Fishes is particularly valuable; 2. Leçons de Physique Expérimentale, in six vols. 12mo; 3. Recueil de Lettres sur l'Electricité, three vols. 12mo, 1753; 4. Essai sur l'Electricité des Corps, one vol. 12mo; 5. Recherches sur les Causes particulières des Phenoménes Electriques, one vol. 12mo; 6. L'An des Expériences, three vols. 12mo, 1770.

NOMADES, a name given in antiquity to several nations, whose whole occupation was to feed and tend their flocks, and who had no fixed place of abode, but were constantly shifting their ground, according to the conveniences of pasturage. The word comes from the Greek, νεμω, *pasco*, I feed.

NOMARCHA, in *Antiquity*, the governor or commander of a nome or department. Egypt was anciently divided into several regions or departments, called *nomes*, from the Greek νομος, taken in the sense of a division; and the officer who had the administration of each nome from the king, was called *nomarcha*, from νομος, and ἀρχη, *command*.

Nombril Point ‖ Nominalists.

NOMBRIL Point, in *Heraldry*, is the next below the fess point, or the very centre of the escutcheon. Supposing the escutcheon to be divided into two equal parts below the fess, the first of these divisions is the nombril, and the lower the base.

NOME, or Name, in *Algebra*, denotes any quantity with a sign prefixed or added to it, and by which it is connected with some other quantity, so that the whole becomes a binomial, trinomial, or the like.

NOMENCLATOR, in Roman antiquity, was usually a slave who attended upon persons who stood candidates for offices, and prompted or suggested to them the names of all the citizens they met, that they might court them and call them by their names, which amongst that people was the highest piece of civility.

Nomenclators, amongst botanical authors, are those who have employed their labours about settling and adjusting the right names, synonymes, and etymologies of names, in regard to the whole vegetable world.

NOMENCLATURE, Nomenclatura, a catalogue of several of the more useful or radical words in any language, with their significations, compiled in order to facilitate the use of such words to those who are to learn the tongue, such as the Latin, Greek, French, and Italian nomenclatures: or it is a system of technical language, by which the objects of any science are denoted, as, for instance, the present language of chemical science, usually called the "new chemical nomenclature," from its recent construction.

NOMINALISTS, a sect of school philosophers, the disciples and followers of Occam, or Ocham, an English cordelier, who flourished in the fourteenth century. They received the denomination of *Nominalists*, because, in opposition to the *Realists*, they maintained that general terms, and not things or images, are the objects of the mind when engaged in abstract reasonings or inquiries.

This sect had its first rise towards the end of the eleventh century, and pretended to follow Porphyry and Aristotle; but it was not till Occam's time that they bore the name of Nominalists. The chief of this sect, in the eleventh century, was a person named John, who, on account of his logical subtilty, was called the sophist; and his principal disciples were Robert of Paris, Roscelin of Compiègne, and Arnoul of Laon. At the beginning the Nominalists had the upper hand; but the Realists, though greatly divided amongst themselves, were supported by men of eminent abilities, such as Albertus Magnus, Thomas Aquinas, and Duns Scotus. The Nominalist sect thus fell into disrepute, till Occam, in the fourteenth century, again revived it, and filled France and Germany with the flame of disputation. His followers having joined the party of the Franciscan monks, who strenuously opposed John XXII., that pope himself, and his successors after him, left no means untried to extirpate the philosophy of the Nominalists, which was deemed highly prejudicial to the interests of the church; and hence it was that, in the year 1339, the university of Paris, by a public edict, solemnly condemned and prohibited the philosophy of Occam, which was that of the Nominalists. The consequence was, that the Nominalists flourished more than ever. In the fifteenth century the controversy was continued with more vigour and animosity than before; and the disputants, not content with using merely the force of eloquence, had frequently recourse to more dangerous weapons, and battles were the consequence of a philosophical question which neither side understood. In most places, however, the Realists maintained a superiority over the Nominalists. Whilst the famous Gerson and the most eminent of his disciples were living, the Nominalists were in high esteem and credit in the university of Paris; but, upon the death of these patrons, the face of things changed much to their disadvantage. In the year 1473, Louis XI., at the instigation of his confessor, the Bishop of Avranches, issued a severe edict against the doctrines of the Nominalists, and ordered all their writings to be seized and secured, that they might not be read by the people; but the same monarch mitigated this edict the year following, and permitted some of the books of that sect to be delivered from their confinement; and, in the year 1481, he not only granted a full liberty to the Nominalists and their writings, but also restored that philosophical sect to its former authority and lustre in the university.

The student of philosophy will do well to examine the researches of Brucker and the other historians of philosophy on the subject of Nominalism, and also to peruse what is to be found on the subject in the works of Mr Dugald Stewart and Dr Thomas Brown.

NOMINATIVE, in *Grammar*, the first case of nouns which are declinable. The simple position, or laying down of a noun, or name, is called the nominative case; yet it is not so properly a case, as the matter or ground whence the other cases are to be formed, by the several changes or inflections given to this first termination. Its chief use is in being placed in discourse before all verbs, as the subject of the proposition or affirmation.

NONA, a city of Dalmatia, now remarkable only for its ruins, but which are so buried by the repeated devastations to which that unhappy city has been exposed, that scarcely any vestige of them appears above ground. "I went thither," says Fortis in his Travels, "in hopes of finding something worthy of notice, but was disappointed. Nothing is to be seen that indicates the grandeur of the Roman times; neither are there any remains of barbarous magnificence to put one in mind of the ages in which the kings of the Croat Slavi had their residence there." It stands on a small island, surrounded by a harbour, which in former times was capable of receiving large ships, but is now become a fetid pool, by means of a little muddy river that falls into it, after a course of about six miles through the rich abandoned fields of that district. The ancient inhabitants turned this water into another channel, and made it run through the valley of Drasnich into the sea; and the remains of the bank raised by them for that purpose are still to be seen. But, notwithstanding the depopulation of this district, and the dreary situation of Nona in particular, the inhabitants have not lost courage, but, animated by the privileges granted to them, have endeavoured to bring the population and agriculture once more into a flourishing state. Proper drains for the water would not only render that rich territory habitable, but moreover very fertile; and the brackish marsh that surrounds the walls of Nona is well calculated to supply a considerable quantity of fish, especially eels. The government generously granted the investiture to private persons, who have derived no inconsiderable advantage from the fishing; and if they had adopted better methods, they might every year salt many thousands of eels, which would prove highly advantageous as an article of commerce, and save at least a part of the money that goes out of the country for foreign salt fish. To the left of the city of Nona appear the walls of some ancient ruinous buildings, which probably in ancient times were situated on the main land, though now surrounded by water. The sea forms a narrow channel in this place, which is easily fordable, and at low water the smallest boat can scarcely pass.

NONAGE, in *Law*, signifies generally all the time that a person continues under the age of twenty-one; but in a special sense, it is all the time that a person is under the age of fourteen.

NONAGESIMAL, or NONAGESIMAL DEGREE, called also the Mid Heaven, is the highest point, or ninetieth degree of the ecliptic, reckoned from its intersection with the horizon at any time; and its altitude is equal to the angle which the ecliptic makes with the horizon at their intersection, or equal to the distance of the zenith from the pole of the ecliptic. It is much used in the calculation of solar eclipses.

NONAGON, a figure having nine sides and angles. In a regular nonagon, or that the angles and sides of which are all equal, if each side be 1, its area will be $6\cdot1818242 = \frac{9}{4}$ of the tangent of 70° to the radius 1.

NONCONFORMISTS, those who refuse to join the established worship. Nonconformists are in England held to be of two sorts. First, those who absent themselves from divine worship in the established church through total irreligion, and attend the service of no other persuasion. Secondly, those who offend through what churchmen call a mistaken or perverse zeal. By the English laws enacted since the time of the Reformation, Papists and Protestant dissenters were considered as conformists of this class, and both were supposed to be equally schismatics, in not communicating with the national church; with this difference, that the Papists divided from it upon material though erroneous reasons, but many of the dissenters upon matters of indifference, or, in other words, for what was thought no reason at all. "Yet certainly," as Sir William Blackstone observes, "our ancestors were mistaken in their plans of compulsion and intolerance. The sin of schism, as such, is by no means the object of temporal coercion and punishment. If, through weakness of intellect, through misdirected piety, through perverseness and acerbity of temper, or, which is often the case, through a prospect of secular advantage in herding with a party, men quarrel with the ecclesiastical establishment, the civil magistrate has nothing to do with it, unless their tenets and practice are such as threaten ruin or disturbance to the state. He is bound, indeed, to protect the established church; and if this can be better effected by admitting none but its genuine members to offices of trust and emolument, he is certainly at liberty so to do, the disposal of offices being matter of favour and discretion. But this point being once secured, all persecution for diversity of opinions, however ridiculous or absurd they may be, is contrary to every principle of sound policy and civil freedom. The names and subordination of the clergy, the posture of devotion, the materials and colour of the minister's garment, the joining in a known or unknown form of prayer, and other matters of the same kind, must be left to the option of every man's private judgment." See TOLERATION.

NON-NATURALS, in *Medicine*, are so called, because by their abuse they become the causes of diseases. Physicians have divided the non-naturals into six classes, namely, the air, meats and drinks, sleep and watching, motion and rest, the passions of the mind, the retentions and excretions.

NON-OBSTANTE, *notwithstanding*, a clause frequent in statutes and letters-patent, importing a license from the king to do a thing which at common law might be lawfully done, but, being restrained by act of parliament, cannot be done without such license.

NON-SUIT signifies the dropping of a suit or action, or the renouncing thereof, by the plaintiff or defendant; which most commonly happens upon the discovery of some error in the plaintiff's proceedings when the cause is so far proceeded in that the jury are ready at the bar to deliver in their verdict.

NONES, *nonæ*, in the Roman calendar, the fifth day of the months of January, February, April, June, August, September, November, and December; and the seventh of March, May, July, and October. March, May, July, and October, had six days in their nones; because these alone, in the ancient constitution of the year by Numa, had thirty-one days each, the rest having only twenty-nine, and February thirty; but when Cæsar reformed the year, and made other months contain thirty-one days, he did not allot them six days of nones.

NONJURORS, those who refused to take the oaths to government, and who were in consequence under certain incapacities, and liable to certain severe penalties. It can scarcely be said that there are now any nonjurors in the kingdom; and it is well known that all penalties have been removed both from Papists and Protestants, formerly of that denomination, as well in Scotland as in England. The members of the Episcopal church of Scotland were long denominated nonjurors; but they are now improperly called so, because the ground of their difference from the establishment is more on account of ecclesiastical than of political principles.

NONIUS, Peter, in Spanish *Nunez*, a learned Portuguese, and one of the most able mathematicians of the sixteenth century, was born at Alcacer. He was preceptor to Don Henry, son of Emmanuel, and taught mathematics in the university of Coimbra. He published the following works, by which he gained great reputation, viz. 1. De Arte Navigandi; 2. Annotationes in Theorias Planetarum Purbachii, which are greatly esteemed; 3. A treatise De Crepusculis; 4. A treatise on Algebra. It is observed in Furetière's Dictionary, that Peter Nonius, in 1530, first invented the angles of 45 degrees made in every meridian, and that he called them *rhumbs* in his language, and calculated them by spherical triangles. Nonius died in 1577, aged eighty.

Nonius, the name given to the common device for subdividing the arcs of quadrants and other astronomical instruments, from the persuasion that it was invented by the above-named Nonius or Nunez. The generality of astronomers, however, transferring the honour of the invention from Nunez to Peter Vernier, a native of Franche Comté, have called this method of division by his name. But Mr Adams, in his Geometrical and Geographical Essays, has shown that Clevius the Jesuit may dispute the invention with both of them. The truth seems to be, that Nunez started the idea, Clevius improved it, and Vernier carried it to its present state of perfection. The method of Nunez, described in his treatise *De Crepusculis*, printed at Lisbon in 1542, consists in describing within the same quadrant 45 concentric circles, dividing the outermost into 90 equal parts, the next within into 89, the next into 88, &c. till the innermost was divided into 46 only. On a quadrant thus divided the plumb-line or index must cross one or other of the circles very near a point of division; and hence, by computation, the degrees and the minutes of the arch may be easily ascertained. This method is also described by Nunez in his treatise *De Arte atque Ratione Navigandi*, where he would fain persuade himself that it was not unknown to Ptolemy. But as the degrees are thus divided very unequally, and as it is very difficult to attain exactness in the division, especially when the numbers into which the arches are to be divided are incomposite, the method of diagonals, first published by Digges, in a treatise entitled *Aleæ seu Scalæ Mathematicæ*, printed at London in 1573, and said to be invented by one Richard Chenseler, was substituted in its stead. Nonius's method, however, was improved at different times and by different persons; and it must be acknowledged, that if Vernier saw either the original or any of the improvements (and there can be little doubt of his having seen them all), his merit consists only in having applied to an useful practical purpose the speculative invention of another person.

NONNUS, a Greek poet of the fifth century, and a native of Panopolis, in Egypt. He was the author of an heroic poem in forty-eight books, entitled *Dionysiacorum*, and a paraphrase in verse of St John's Gospel, which may serve as a commentary thereupon.

NOOGOO, one of the small Friendly Islands, three miles north-east from Tongataboo.

NOOGOONAMO, one of the Hapaee Islands, a little to the south-east of Haano.

NOOHEVA, or Federal Island, one of the Ingraham Islands, in the Pacific Ocean. Long. 140. 5. W. Lat. 8. 58. S.

NOOLDROOG, the capital of a district of Hindustan, in the province of Bejapoor, situated between the 17th and 18th degrees of north latitude. Long. of the town 76. 37. E. Lat. 17. 42. N.

NOONTAL, a small and mountainous district of Northern Hindustan, in the province of Cashmere, situated about the 35th degree of north latitude.

NOOPORE, a town of Hindustan, in the province of Gujerat. Long. 73. 50. E. Lat. 21. 11. N.

NOORABAD, a town of Hindustan, in the province of Agra, situated on the Sank River, over which there is a bridge of seven arches, built of stone. Adjoining there is a large garden, laid out by Aurungzebe as a monument to the memory of Goona Begum, a princess of great personal and mental accomplishments. The shrine contains this Persian inscription: "Alas, alas, Goona Begum." Long. 78. 6. E. Lat. 26. 25. N.

NOORNAGUR, the capital of a district of the same name, in Bengal, situated at the foot of the Tipperah Mountains. Long. 91. 5. E. Lat. 23. 45. N.

NOORPEELY, a town of Hindustan, in the province of Orissa, twenty miles north of Jager.

NOORRI, a village of Hindustan, in the province of Sinde, situated on the banks of the Fulalee, fifteen miles below Hyderabad, between which city and the river there is a free intercourse. Lat. 25. 8. N.

NOOTKA, or Vancouver's Island, an island of New Georgia, on the western coast of North America. Black granite, mica, grit for grindstones, and hematites, are found there. In some places the vegetable earth forms a bed of two feet in thickness. The climate here is favourable to vegetation, being much milder than that of the eastern coast of America in the same latitude. Nootka Sound, situated in latitude 49. 35. north, and longitude 126. 36. west, was discovered by Captain Cook in 1778. The water in the sound is from forty-seven to ninety fathoms deep, and there are many anchoring places and good harbours. All the mainland opposite this island, comprising New Georgia, New Hanover, and New Albion, is claimed by the United States, and generally goes by the name of the Western Territory. See Western Territory.

NORD, a department of France, and, as its name denotes, the most northern of the kingdom. It has been formed out of French Flanders, French Hennegau, and the Cambresis, extending in north latitude from 49. 58. to 51. 5., and in east longitude from 2. 1. to 3. 9. Its surface is 2406 square miles, or 581,500 hectares, in extent. It is a level plain, with few elevations; and only one of them, the hill on which Cassel stands, attains the height of 400 feet above the level of the sea. The soil is generally moist and heavy, but, owing to good cultivation, is highly fertile, except on some sandy moors on the sea-shore near Dunkirk. According to the *Description Topographique et Statistique*, the land under the plough amounts to 326,430 hectares, the meadows to 138,428, the woodland to 62,129, the morass and other uncultivated fields to 15,000; and the remainder is occupied by rivers, roads, gardens, and the sites of cities, towns, and villages. In no other part of France is agriculture practised with so much skill and assiduity as in this department. The fields, by good ploughing and abundance of manure, yield crops constantly without fallowing; and corn is almost generally followed by green crops, which, especially the clover, is only to be matched in the province of Flanders, in the Netherlands. Abundance of wheat, winter and summer barley, oats, es and the several kinds of pulse, are produced; and although the land is not quite two English acres to each individual of the population, the produce is more than sufficient for their consumption, and much of it is exported.

The department is watered by numerous streams, the greater part of which are emptied into the Scheldt, which enters from the department of the Aisne, and, after a course of about forty-five miles, passes through the Netherlands to the sea. Some few of the rivers fall directly into the sea, and others reach it by the Sambre and the Meuse. There are several canals, used either for navigation or for the purpose of irrigation. The inhabitants of the department amount to about 900,000, who, besides the employment connected with agriculture, are occupied in the fisheries, and in manufactures. The sea-fishing consists in the taking of herrings, cod, turbot, and others, and is extended also to the Greenland whale-fishery; whilst that on the rivers and canals furnishes a large portion of food. The chief manufacture is that of linen, including cambrics, damask table-linen, lawns, and thread-lace. This is said to employ 40,000 looms, and to furnish occupation for more than 160,000 persons in spinning. Some woollen and cotton goods are also made, as well as hats, hosiery, and leather. There are likewise many oil-mills, breweries, and distilleries of corn-spirits. The chief trade is carried on at Lush, but there are also extensive works at Douay, Cambray, Dunkirk, and Valenciennes. This department belongs ecclesiastically to the bishopric of Cambray. The chief court of law is held at Douay; and the department elects eight deputies to the legislative body. The religion is that of the Roman Catholic church, though there are a few Protestants, who support three chapels or churches for their worship.

Nord, *Côtes du*, a department of France, formed out of a part of the ancient province of Bretagne, and extending in north latitude from 48. 16. to 48. 56. and in west longitude from 2. 12. to 3. 49. It is bounded on the north by the sea, on the east by the department of Ille Vilaine, on the south by that of Morbihan, and on the west by Finisterre. It is 3022 square miles, or 736,720 hectares, in extent, and contains five arrondissements, forty-seven cantons, and 376 communes, with a population of 540,000 persons. It is a level plain, interspersed with a few gentle elevations. The shore is covered with rocks and small islands, and encircled by a belt of sandy soil, but intermixed with a few rich meadows near the rivers. The streams are all of but short course, and only navigable at the time of high tides. The climate is temperate, but moist and changeable. Agriculture is in a backward state, as is the civilization of the inhabitants, who speak for the most part a kind of Welsh, and live mostly in small villages or little farms; but, by subsisting chiefly on bread made of oats or buck-wheat, they furnish grain sufficient for their own consumption, and produce, besides, hemp and flax, which are converted into wearing apparel in their own houses, or made into sail-cloth and other articles. The fisheries give employment to some of the inhabitants; and iron mines, of which there are a few, furnish occupation to others. Much honey and bees' wax is obtained from the department. It sends four deputies to the legislative chamber.

NORDBOTTENS and Wasterbottens, two provinces of the most northern part of Sweden, now formed into one, extending in north latitude from 63. 28. to 69. 20., and in east longitude from 15. 1. to 24. 2., and having an extent of 66,396 square miles. It is a mountainous country, interspersed with lakes. The winter lasts nine months, during which the surface is covered with snow; but in a few sheltered spots a little rye and barley, and some flax and hemp, may be cultivated. In the most northern part few trees grow, but in the south there are some birches and firs. The cows yield some butter; but the chief animals are the rein-deer, which form a great article of food. The whole population is estimated at 75,000. There are no places in the province that can be considered as towns, though Tornea and Pithea are called so.

NORDEN, Frederick Louis, an ingenious traveller and naval officer in the Danish service, was born at Gluckstadt, in Holstein, in the year 1708. He was well skilled in the mathematics, ship-building, and especially in architecture; and in 1732 he obtained a pension to enable him to travel for the purpose of studying the construction of ships, particularly that of the galleys and other rowing vessels used in the Mediterranean. He spent nearly three years in Italy; but Christian VI. being desirous of obtaining a circumstantial account of Egypt, Mr Norden, whilst at Florence, received an order to extend his travels to that country. How he acquitted himself of this commission appears from his Travels into Egypt and Nubia, printed at Copenhagen in 1756, and which were soon afterwards translated into English by Dr Peter Templeman. In the war between England and Spain, Mr Norden, then a captain in the Danish navy, attended Count Ulric Adolphus to England, whence they went out as volunteers under Sir John Norris, and afterwards under Sir Chaloner Ogle. During his stay in London, Mr Norden was made a fellow of the Royal Society, and gave the public drawings of some ruins and colossal statues at Thebes, in Egypt, with an account of the same in a letter to the Royal Society, 1741. His health was at this time declining, and having repaired to France, he died at Paris in 1742.

Norden, a seaport town of the kingdom of Hanover, in the province of East Friesland, and the capital of the bailiwick of the same name. It stands at the mouth of the river Leysand, but the harbour is not good; and it contains 814 houses, with 4917 inhabitants. It is much resorted to in the summer as a sea-bathing place, and there are several distilleries and breweries, with some export of corn. Long. 7. 6. 1. E. Lat. 53. 35. 57. N.

NORDHAUSEN, a city, the capital of the circle of Holstein, in the Prussian province of Erfurt, on the river Zorge. It is an ancient town, surrounded with walls, and defended by several towers, and it contains one Catholic and seven Lutheran churches, with 1456 houses, and 9684 inhabitants, who are manufacturers of woollen cloths, especially flannels, lackered ware, leather, seed-oil, corn-spirits, nails, soap, and hats, besides many smaller articles. There is also a considerable trade in corn, cattle, wool, and bacon. Nordhausen contains a school of considerable celebrity, three hospitals, and an orphan-house. Long. 10. 43. 40. E. Lat. 51. 30. 22. N.

NORDLAND, a province in the most northern part of Norway, extending over 45,000 square miles, the whole of which, with a slight exception, is within the polar circle. It is divided into two bailiwicks, Nordland and Finmark, which together contained in 1801 a population of 78,425 persons; but, within the thirty-six years that have since elapsed, it is supposed to have somewhat increased. The climate forbids extensive agriculture, but some little barley is grown as high as the latitude of seventy degrees. The chief subsistence of the inhabitants depends on the fisheries and the chase; and the only articles of exportation are salted fish, furs, hides, and feathers, which are sent to Bergen in exchange for the few foreign commodities that are wanted.

NORDLINGEN, a city of Bavaria, in the circle of the Rezat, and the capital of the bailiwick of its own name. It stands on the river Eger, and is surrounded with walls, defended by towers and bastions, and with ditches. It contains 780 houses, and 6130 inhabitants, who make flannels, carpets, blankets, and other woollen goods, and have considerable trade in wool, corn, and leather. Long. 10. 23. 10. E. Lat. 48. 51. N.

NORES, Jason de, a scholar, poet, and philosopher, Norfolk.

was born at Nicosia, in Cyprus. Having lost his fortune when the Turks made themselves masters of that island in 1570, he retired to Padua, where he acquired great reputation by teaching ethical philosophy. His character had that cast of severity which is often the consequence of scholastic habits. He was one of those men who discuss every thing without being capable of thoroughly understanding any thing. The *Pastor Fido* of Guarini made its appearance, and in consequence pastorals became a fashionable species of reading throughout all Italy. Nores, who did not relish works of this kind, attacked the production of Guarini, who entirely confuted him in a little piece printed at Ferrara in 1588. Nores made a reply two years afterwards; and the poet was preparing an answer still more severe than the former, when his antagonist died of grief, occasioned by the banishment of his only son for having killed a Venetian in single combat. He left behind him a great many works, some in Italian, and others in Latin. The principal of his Italian works are, 1. Poeticks, Padua, 1588, 4to; 2. A Treatise on Republics, 1578, 4to; 3. A Treatise on the World and its Parts, Venice, 1571, 8vo; 4. Introduction to three books of Aristotle's Rhetoric, Venice, 1548, 4to; 5. A Treatise on the aid which Comedy, Tragedy, and Epic Poetry, may receive from Moral Philosophy. His Latin works are, 1. Institutio in Philosophiam Ciceronis, Padua, 1576, 8vo; 2. Brevis et distincta Summa Præceptorum de Arte Discendi, ex libris Ciceronis collecta, Venice, 1553, 8vo; 3. De Constitutione partium Humanæ et Civilis Philosophiæ, 4to; 4. Interpretatio in Artem Poeticam Horatii. In all his works we remark great perspicuity and accuracy, profound erudition, and happy expressions, with a compact and sometimes forcible style.

NORFOLK, an English maritime county, bounded on the northern and north-eastern sides by the German Ocean, on the south and south-east by the county of Suffolk, and on the west by the counties of Lincoln and Cambridge. The shape is nearly that of an ellipsis bounded by a convex line, a little indented on the western extremity. Its greatest length is fifty-nine miles, and its greatest breadth thirty-eight. According to the most recent calculation, as made by Mr Rickman, the number of acres is 1,292,300.

The population, according to the returns at the four decennial enumerations, appears to have amounted in 1801 to 273,371, in 1811 to 291,999, in 1821 to 344,366, and in 1831 to 390,000. The annual value of the real property of the whole county, as taken for the property-tax in 1815, amounted to L.1,540,952.

The burials, including both the registered and the unregistered, in the ten years from 1821 to 1831, appear to have been one in fifty-two of the whole number of inhabitants then living. The illegitimate births were one in nineteen of the whole number born.

The occupations of the inhabitants, according to the returns arranged by Mr Rickman in 1831, were as follow:

Occupiers of land employing labourers	5,229
Occupiers of land not employing labourers	2,718
Labourers employed in agriculture	37,466
Employed in retail trades or handicraft	26,543
Capitalists, bankers, &c.	3,116
Labourers not agricultural	6,577
Other males twenty years of age	93,498
Male servants	2,022
Female servants	14,490

The surface of this county presents less variety than almost any other in England. It is generally a level plain, with few undulations, and no bold or abrupt elevations. With the exception of some recently-planted districts around the seats of noblemen and gentlemen, the woody parts of the county are very inconsiderable; and there is generally a great scarcity of the more umbrageous trees. The streams have almost all a languid and sombre appearance. Though, to the traveller of taste, the sameness and uniformity is wearisome, yet to him who directs his attention to the wealth and comforts of the districts through which he journeys, few countries can be more pleasing. The number and substantial appearance of the farm-houses, and even of the cottages, the condition of the roads and fences, and the high cultivation of the fields, are marks of rural prosperity that are nowhere more striking. Some few portions on the eastern side of the county form exceptions to this general description, but these are inconsiderable when compared with the whole.

Norfolk.

From its exposure to the North Sea, the winters in Norfolk are usually severely cold, and the powers of vegetation are retarded to a later period of the year than in the western counties. In the hundred of Marshland the climate is not only cold, but damp; and the inhabitants are subject to intermitting fevers, which commonly attack all strangers who come to reside in that district. The soil of Norfolk is generally a light sand or sandy loam; for although a part of the fens are within the county, and the district of Marshland consists of ooze formed by deposition from the sea, as well as a narrow tract of land upon the banks of the river Waveney, yet these form but trifling exceptions to the general character of the soil of the county. Mr Arthur Young, in his Agricultural Survey of Norfolk, has made an attempt to classify the soils, and estimate their quantities. The difficulty of doing this with accuracy must be acknowledged by every one who considers the nice gradations which soils discover, and how various are their modifications. We give this estimate rather as an approximation to the truth than as absolutely exact.

Soils.	Square Miles.	Acres.
Light sand	220	140,800
Good sand	420	268,000
Marshland clay	60	38,400
Various loams	900	576,000
Rich loams	148	94,720
Peat	82	52,480

Since the land of Norfolk, from the representation here given, appears to be far from being naturally of a fertile description, the great amount of its productions must be attributed to the excellent system of agriculture which has been there introduced and extended, and which, though scarcely calculated for most of the other districts of our island, is admirably adapted for the soil and climate where it is pursued. The foundation upon which the whole system of its agriculture is built is the cultivation of turnips. These light soils are easily brought into a fine tilth by repeated ploughings and harrowings, and their produce maintains so large a portion of live stock, that their manure, when carefully preserved, and properly distributed, enriches the soil at every successive course more than it is impoverished by the crops of corn which are grown upon it. The land is thus in a constantly progressive state of improvement. The soil being so light, no deep ploughing is required, but such a repetition of moving it as will be sufficient to destroy the surface weeds, and to pulverize it effectually. This is easily effected by means of well-constructed light ploughs, drawn by two horses, which are guided by reins in the hands of the man who directs the plough. In many instances a four-course system of rotation is followed, consisting of turnips, barley, artificial grasses, and wheat. In some instances the artificial grasses are left two years in the ground, and then, after three or four ploughings, the wheat is sown. A very common rotation, provincially termed the six-course shift, is wheat, barley with or without clover, turnips, barley or oats, clover mown for hay, clover fed, and then wheat again. Both these systems, with the varieties of each, are founded upon the principle that as much land shall be cultivated with green crops which furnish sustenance for cattle, and thereby produce manure, as is destined to the growth of corn. The system of drill-husbandry is carried to a great extent, and the practice of planting or dibbling grain of all kinds has been of late years very much and beneficially increased. By perseverance in these excellent plans, many extensive portions of the county of Norfolk, especially in the north-eastern part of it, which were a few years ago deemed incapable of producing a wheat crop, now yield abundant harvests of that grain. Oats are but a small object of cultivation; but barley is deemed the grain most appropriate to the soil and climate, and is consequently sowed to the greatest extent, occupying nearly one fourth of the arable land of the county. The increase of grain varies very considerably. On the heavy soils of Marshland and Flegg the produce of wheat is frequently six quarters, and of oats ten quarters, to the acre; but as these districts form but a small proportion of the whole, the average quantity of wheat in the county is about three quarters to the acre, and of barley four quarters. In no part of the kingdom have the various mechanical inventions for facilitating agricultural labour been so generally diffused as in Norfolk; and the implements used there may well serve as models for the other counties. Besides the common grains, wheat, barley, oats, pease, and beans, this county yields mustard, saffron, flax, and hemp; but none of them in such quantities as to merit especial notice.

The live stock of this county possess few peculiarly discriminative features. The horses, crossed by the breed of Suffolk, are bony, active, and hardy, and well adapted for husbandry or the road; and they are almost universally used for agricultural labour, to the exclusion of oxen. The native cows were a small breed, not unlike those of Alderney and Guernsey; but they have been improved by a mixture with the cows of the richer adjoining counties. The greater part of the cattle fattened in Norfolk are bought from the Scotch drovers, who bring them to the fairs about Michaelmas. They are fed upon the banks of the rivers on the natural grass, or upon the arable farms on turnips, till they become fit for slaughter. The number of Scotch cattle annually bought by the Norfolk farmers is estimated to vary from 15,000 to 20,000. The original sheep of Norfolk were a very hardy race, with horns, black feet, and black noses, the fleece yielding about two pounds of wool of third-rate fineness, and the quarters weighing, when fattened, about eighteen pounds. They were well calculated for the land when it was less highly cultivated than at present, as they were good travellers, and ate the herbage very close; but as the improved systems of husbandry have been extended, this native breed has sometimes been crossed by others, and in many instances has given place to the South Down sheep. The increase of arable farms has diminished the dairies, and consequently the pigs which were reared from them; and the practice of fattening hogs for bacon is scarcely known.

The poultry of Norfolk has been long celebrated, and vast quantities of it are conveyed to the London markets. The turkeys are most highly prized, from their superior delicacy of flavour. The dry nature of the soil is deemed peculiarly favourable to the rearing of these birds; and the numbers which are sent from Norfolk to other districts amount to hundreds of thousands. No part of England is so abundantly stocked with game, especially pheasants and partridges, as Norfolk. They are sedulously preserved by the landlords, and generally reserved in the leases, so that they have obtained the character of property, and are commonly respected as such by adjoining proprietors of estates. Great numbers of rabbits are bred on extensive warrens in many parts of the county, both for the sake of the flesh and of the wool.

Norfolk has long been and still continues to be an extensive manufacturing county. The Flemings first settled here as early as the year 1336, and made woollen goods at the village of Worstead; hence the name of that place was applied to the thread made of the longer kinds of wool. Under the persecutions of the Duke of Alva in Flanders, many more natives of that country found refuge in and near the city of Norwich. The fabrics have indeed successively changed with the change of fashions and the fluctuations of markets, but the manufactures have been continued through many vicissitudes to the present time. The chief goods now manufactured are bombazeens, camblets for the markets of China, and shawls of various and elegant kinds, principally for home consumption. This last article, introduced when the demand for stuffs from Spain ceased, has been highly beneficial to the city of Norwich and its vicinity. The introduction of machinery in the northern counties had destroyed the habit of spinning, which, a few years ago, universally prevailed amongst all the females of the peasants' families in this and the adjoining counties. Besides the manufactories of Norwich and its vicinity, some inferior kinds of bone-lace are made in Diss, and some other parts of the county; but the quantity produced is slowly and gradually diminishing.

Scarcely any of the goods manufactured in this county are sent directly to foreign markets, those destined for distant countries being almost wholly exported from London. The commerce is notwithstanding very extensive, from the two ports of Yarmouth and Lynn. Yarmouth, in regard to the number of its ships, is the eighth port in the kingdom, having more than 300 registered vessels. It is well situated for trade, and has one of the finest quays in Europe; but the depth of water is not sufficient for ships of great draft, and the bar at the mouth of the harbour is a serious impediment. The great support of the shipping of Yarmouth is the herring fishery. These fish are caught by the Yarmouth men, in the months of June and July, on the shores and in the lochs of Scotland, and at a later period on their own coasts. They are first cleaned, and then slightly salted; after which they are hung up in large appropriate houses, where, by the application of the smoke of wood fires, the preparation of curing them is completed. This fishery usually yields from 80,000 to 100,000 barrels of red herrings, each barrel containing about 1000 fish. This branch of industry, besides the employment of the seamen, gives occupation to several thousand artificers of various kinds. Besides this fishery, the exports of Yarmouth, as well as Lynn, and the smaller ports of Wells, Blackney, Burnham, and Clay, afford great employment to shipping, by the surplus quantity of corn which the county produces and sends to London and other ports. The imports at these towns consist of timber, hemp, wine, spirits, and foreign fruit; which, by means of the navigable rivers, are forwarded to the interior adjoining counties.

The rivers are sufficiently easy of navigation to render canals unnecessary, and there are consequently none in the county, though several have been commenced, and, after languishing some time, have been abandoned without being completed. The Great Ouse is a navigable river, which rises in Northamptonshire, enters this county at Downham, and empties itself into the sea near Lynn. It has a great rise of tide, and is navigable for barges twenty-four miles from its mouth, and for boats as far as Bedford; thus affording water communication with seven of the midland counties. The Little Ouse rises in the southern part of this county; at Thetford it receives the small river Thet, and from thence is navigable to its junction with the Great Ouse, on the borders of Cambridgeshire. The Waveney rises within nine or ten feet of the source of the Little Ouse, and takes a directly opposite course. It has many sinuosities, as its name denotes, becomes navigable at Bun-

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gay, receives the Yare at Burgh, and empties itself into the sea at Yarmouth. The Bure rises near Aylsham, and after joining the Thone near North Walsham, becomes navigable for boats. It falls into the Yare previously to its meeting the sea. The Yare rises near Attleburgh, becomes navigable at Norwich, and, after receiving the waters of the Tass and the Wensum, merges in the Waveney. Recently a communication directly from Norwich to the sea has been formed by a canal to Lowestoff. The Nar rises near Litcham, and has a short course to the sea at Lynn, whence it is navigable upwards to Narborough, a distance of fifteen miles.

The whole of the county is within the diocese of Norwich, the bishop of which see has his palace and cathedral in that city. The titles derived from the county are that of duke to the family of Howard; Earl of Norwich to the Scotch Duke of Gordon, and of Yarmouth to the Marquis of Hertford, Marquis and Viscount Townsend; Viscount Thetford to the Duke of Grafton; Barons Walsingham, Calthorpe, Wodehouse, Hobart, Walpole, and Nelson. Norfolk, under the reform act, was divided into two portions, each returning two members. The election for the eastern division is held at Swaffham, and the polling places are Downham, East Deerham, Fakenham, Lynn Regis, Swaffham, and Thetford. The election for the western division is held at Norwich, and the polling places are that city and the towns of Long Stratton, North Walsham, Reepham, and Yarmouth. Besides the four members for the county, the following places return two each, viz. Norwich, Yarmouth, Thetford, and Lynn Regis. Castle Rising, which before the change returned two members, has been disfranchised.

This county contains few Roman antiquities, but some of Saxon date are to be seen in the cathedral, the episcopal palace, the gates of Yarmouth and Lynn, and in several piles of ruins of ecclesiastical edifices, as well as in some of the parish churches. Amongst many distinguished natives of this county, the most celebrated have been Anne Boleyn, Dr Samuel Clarke, Sir Edward Coke, Archbishops Herring and Parker, Lord Nelson, Richard Porson, Sir Robert Walpole, and the Right Honourable William Windham.

In so large a county we may naturally expect to find many seats of noblemen and gentlemen. It would far exceed the limits which the nature of this work prescribes, to enumerate one half of them; but the most remarkable are the following:—Bickling, Lord Suffield; Binley Hall, Earl of Rosebery; Bracon Ash, T. F. Berney, Esq.; Buckenham House, Lord Petre; Costessey Hall, Sir William Jerningham; Felbrigg, Captain Lukin; Harling, Sir John Sebright; Hethel Hall, Sir Thomas Beevor; Hillington Park, Sir Martin Folkes; Houghton Hall, the Marquis of Cholmondeley; Intwood Hall, Earl of Buckinghamshire; Gunton, Lord Suffield; Kimberley Hall, Lord Wodehouse; Kirby Bedon, Sir John Berney; Melton Constable, Sir J. H. Astley; Quiddenham, Earl of Albemarle; Rainham Hall, Marquis of Townsend; Wareham, Sir M. B. Folkes; Wolterton Hall, Earl of Orford; Oxburgh Hall, Sir Richard Boddingfield.

The towns having a population exceeding 1500 inhabitants are the following:—

	Inhabited Houses.	Inhabitants.
Norwich	13,156	61,116
Yarmouth	4,570	21,115
Lynn	2,707	13,370
East Deerham	785	3,913
Wells	734	3,624
Thetford	675	3,462
Swaffham	626	3,285
Diss	559	2,934
North Walsham	560	2,615
Aylsham	484	2,334
Downham	458	2,198
Upwall	390	2,123
Fakenham	383	2,077
Attleburgh	372	1,939
Shipdam	376	1,889
Harlestone	357	1,784
Holt	306	1,622
Hingham	308	1,539

Norf. | Norham.

Norfolk, a borough-town and a port of entry in Norfolk county, Virginia, one of the United States of North America. It is situated on the north-eastern side of Elizabeth River, eight miles above its entrance into Hampton Road, and thirty-two miles from the sea. The land side of the town is not pleasant, being low, and in some places marshy. The streets are crooked and irregular, and neither the public nor the private buildings are remarkable for elegance. Of the former there are above twenty, including places of public worship for Episcopalians, Presbyterians, Baptists, Roman Catholics, and Methodists. The Farmer's Bank, the Orphan Asylum, and the Lancasterian School, are amongst the most conspicuous structures in Norfolk. It has a spacious and commodious harbour, nearly a mile in width, defended by three forts: Fort Norfolk on the north-east side of Elizabeth River, about a mile below the town; Fort Nelson on the south-west side of the river, a little higher than the former; and a large and strong fort upon Craney Island, five miles below the town. Norfolk has more shipping and maritime commerce than any other town in the state. On Washington Point, between the eastern and western branches of the river, there is a marine hospital, a handsome brick edifice. Near this town, also, there is an United States navy yard. The population of Norfolk amounted in 1820 to 8478, and in 1830 to 9816. Long. 76. 10. W. Lat. 36. 52. N.

Norfolk Island, in the Southern Pacific Ocean, is fifteen miles in circumference. It was discovered in 1774 by Captain Cook, who found it uninhabited. It has a remarkably fruitful soil; the whole country is clothed with verdure, and presents a scene of most exuberant fertility. It is described by Turnbull, who visited it in 1801, as being so uniformly fertile, that, with the exception of the mountains overhanging the sea, it would be difficult to find one spot less fertile than another. This island was colonized shortly after that of Port Jackson, by Governor Philips, who sent thither the more profligate division of the colonists; and the most abandoned convicts were afterwards sent to the same place. One great objection to the island as a colonial settlement is the difficulty of approaching it, in consequence of the mountainous sea which constantly beats on its rocky shores, so that ships from Port Jackson have often been obliged to beat off and on for upwards of a month, and found themselves still as distant as ever from all communication with the shore. This circumstance, and the want of any harbour or roadstead for shipping, is much against the island; and hence, in 1805, it was found necessary to remove the colonists and convicts either to Port Dalrymple or to the river Derwent. The population amounts to 1000. Long. 168. 10. E. Lat. 29. 3. S.

Norfolk Sound, according to the account of Captain Dixon, is situated in 57. 3. north latitude, and 135. 36. west longitude. It is a very extensive place, but how far it stretches to the northward is not known.

NORHAM, a township, the capital of the parish of the same name, in the district of Norhamshire, county-palatine of Durham, pleasantly situated on the south side of the river Tweed, nine miles above Berwick. It is celebrated for being the frequent scene of forays during the wars between England and Scotland, probably because one of the principal fords across the Tweed between Berwick and Kelso is only at a short distance above the village. Norham, in its present state, appears to have been built from the ruins of the celebrated castle situated at its eastern extremity. It has been much improved, and is now kept free from the filth which was formerly allowed to accumulate on its streets. The cross, which is at the west end of the village, also adds to its appearance. The church of Norham is of very old date, and has for its middle aisle part of the first church, which was built in the year 840. Before the Reformation, it had the privilege of affording sanctuary for thirty-seven days. There is also a Presbyterian meeting-house and an endowed school in the village. Its inhabitants are principally supported by salmon fisheries on the Tweed, shoe-making, and agricultural employment in the neighbourhood. In consequence of the dangerous state of the ford across the Tweed, and from the river being often impassable, even for boats, when it is swollen with rain, it is in contemplation to construct a chain-bridge across the river. The ruins of the castle are situated on a high rock, which overhangs the river Tweed; they are of considerable extent, and consist of the remains of two sides of the tower or keep, many vaults, with the fragments of other edifices, and the remains of the outward walls, which enclose the castle to a considerable extent. There are also traces of field-works, which appear to have been erected by the forces which besieged it, in order to enable them to reduce it. The ruins have a most picturesque appearance. The inhabitants amounted in 1821 to 901, and in 1831 to 819.

NORIA, an hydraulic machine much used in Spain. It consists of a vertical wheel of twenty feet in diameter, on the circumference of which are fixed a number of little boxes or square buckets, for the purpose of raising the water out of the well, communicating with the canal below, and of emptying it into a reservoir above, which is placed by the side of the wheel. The buckets have a lateral orifice to receive and to discharge the water. The axis of this wheel is embraced by four small beams, which cross each other at right angles, tapering at the extremities, and thus form eight little arms. This wheel is near the centre of the horse walk, contiguous to the vertical axis, into the top of which the horse-beam is fixed; but near the bottom it is embraced by four little beams, forming eight arms similar to those above described, on the axis of the water-wheel. As the mule employed to turn it goes round, these horizontal arms, supplying the place of cogs, take hold, each in succession, of those arms which are fixed upon the axis of the water-wheel, and keep it in rotation.

This machine, than which nothing can well be cheaper, throws up a great quantity of water. Yet it has two serious defects. The first is, that part of the water runs out of the buckets and falls back into the well after it has been raised nearly to the level of the reservoir; and the second is, that a considerable proportion of the water to be discharged is raised higher than the reservoir, and falls into it only at the moment when the bucket is at the highest point of the circle, and ready to descend. But both these defects might be remedied with ease, by leaving the square buckets open at one end, making them swing upon a pivot fixed a little above their centre of gravity, and placing the trough of the reservoir in such a position as to stop their progress whilst perpendicular, make them turn upon their pivot, and so discharge their contents. From the reservoir the water is conveyed by channels to all parts of the garden. These have divisions and subdivisions in beds, some large, and others very small, separated from each other by little channels, into which a boy with his shovel or his hoe directs the water, first into the most distant trenches, and successively to all the rest, until all the beds and trenches have been either covered or filled with water. Mr Townsend thinks, that on account of the extreme simplicity of this machine, it is an invention of the most remote antiquity. By means of it the inhabitants every morning draw as much water from the well as serves throughout the day, and in the evening distribute it to every quarter, according to the nature of their crops. The reservoirs into which they raise the water are about twenty, thirty, or even forty feet square, and three feet in height above the surface of the ground, with a stone cope on the wall, declining to the water, for the women to wash and beat their clothes upon.

NORICUM, a Roman province, situated between the Danube on the north, which separated it from ancient Germany; the Alpes Noricæ on the south; the river Ænus on the west, which separated it from Vindelicia; and Mons Cetius on the east, which divided it from Pannonia. It now includes a great part of Austria, all Saltzburg, Styria, and Carinthia. It was anciently a kingdom under its own sovereigns.

NORIS, Henry, a cardinal, and a great ornament of the monastic order of St Augustin, was descended from the president Jason, or James de Noris, and was born at Verona in 1631. He was carefully educated by his father Alexander Noris, originally of Ireland, and well known by his history of Germany. From his infancy he discovered an excellent understanding, great vivacity, and quick apprehension. His father instructed him in the rudiments of grammar, and procured an able professor of Verona, called Massoleim, to act as his preceptor. At fifteen he was admitted as a boarder in the Jesuits' College at Rimini, where he studied philosophy; after which he applied himself to the writings of the fathers of the church, particularly those of St Augustin; and taking the habit in the convent of the Augustinian monks of Rimini, he in a short time distinguished himself amongst that fraternity by his erudition, insomuch that, as soon as he had completed his noviciate, the general of the order sent for him to Rome, to give him an opportunity of improving himself in the more solid branches of learning. Nor did he disappoint the expectations of his superior. He gave himself up entirely to his studies, and spent whole days, and even nights, in the library of the Angeliques of St Augustin. His constant course was to study fourteen hours a day; and this he continued till he became a cardinal. Thus he became qualified to instruct others, and was first sent to Pezaro, and thence to Perugia, where he took his degree of doctor of divinity; after which, proceeding to Padua, he applied himself to finish his History of Pelagianism. He began it at Rome at the age of twenty-six, and when he had completed his design, the book was printed at Florence, and published in 1673. In the following year the Grand Duke of Tuscany invited him to that city, made him his chaplain, and appointed him professor of ecclesiastical history in the university of Pisa, which his highness had recently founded.

In his history he explained and defended the condemnation pronounced, in the eighth general council, against Origen and Mopsuesta, the original authors of the Pelagian errors; and he also added an account of the schism of Aquileia, with a vindication of the books written by St Augustin against the Pelagians and Semi-Pelagians. The work procured the author great reputation, but called forth several antagonists, to whom he published proper answers. The dispute grew warm, and was carried before the sovereign tribunal of the Inquisition. There the history was examined with the utmost rigour, and the author dismissed without the least censure. It was reprinted twice afterwards, and the author was honoured by Pope Clement X. with the title of qualificator of the holy office. Notwithstanding this, the charge was renewed against the History, and it was delated afresh to the Inquisition in 1676; but it came again out of the trial with the same success as before. Mr Noris was now suffered to remain in peace for sixteen years, and taught ecclesiastical history at Pisa, without any molestation, until he was called to Rome by Innocent XII., who, in 1692, made him under-librarian of the Vatican. This post was a step to a cardinal's hat: his accusers, therefore, took fire afresh, and published several new pieces against him. Upon this the pope appointed some learned divines, who had taken neither side, to re-examine Father Noris's books, and report on them. Their testimony was so advantageous to the author, that his holiness made him counsellor of the Inquisition. Yet this did not prevent one of his adversaries, the most formidable on account of his erudition, from rising up against him, and attacking him warmly, under the assumed title of a Scrupulous Doctor of the Sorbonne. Noris tried to remove these scruples in a work which appeared in 1695, under the title of, An Historical Dissertation concerning One of the Trinity that suffered in the Flesh, in which, having justified the monks of Scythia, who had made use of that expression, he vindicated himself also from the imputation of having attainted the Pope's infallibility, and abused Vincentius Lirinensis, and other bishops of Gaul, as favourers of Semi-Pelagianism, and as having themselves fallen into the errors of the Bishop of Ypres. But his answers to all these accusations were so much to the satisfaction of the pope, that at length, in 1695, his holiness honoured him with the purple.

After this he was in all the congregations, and employed in the most important affairs; so that he had little time to spend in study, a circumstance of which he frequently complained to his friends. Upon the death of Cardinal Casanati, he was made principal keeper of the Vatican Library in 1700, and two years afterwards he was nominated, amongst others, to reform the calendar; but he died at Rome, of a dropsy, in 1704. He was one of the most learned men of his time; his writings abound with erudition, and are also remarkable for their elegance. His works are numerous, and were published at Verona, in 1729 and 1730, in five volumes folio.

NORMANS, a fierce and warlike people of Norway, Denmark, and other parts of Scandinavia. They at different times overran and ravaged most countries in Europe, in the respective histories of which a full account of them will be found.

Norman *Characters*, a species of writing introduced into England by William I. From some old manuscripts, the Norman writing appears to have been composed of letters nearly Lombardic. In regal grants, charters, public instruments, and law proceedings, this character was used with very little variation from the reign of the Conqueror till that of Edward III.

NORRKOPING, a city of Sweden, in the province of Linkoping. It stands on both sides of the river Motala, and is connected together by a bridge of boats. It is a moderately built town; one side of the river rising against the side of a hill, the other part being almost level with the water. The streets are wide and well paved, and there are some handsome squares, with a fine market-place. It contains three churches, one of which is for the Germans. There are several institutions for instruction and for charitable purposes. In 1834, it contained about 2000 houses and 10,500 inhabitants. It is the principal place of trade in the kingdom, next to Stockholm. It has some large fabrics of cutlery, and of all kinds of iron and copper ware. There are refineries for sugar and salt, some weavers of linen, cotton, and woollen goods, manufactories of soap and leather, and conveniences for building ships. The export trade consists of iron, steel, and copper in bars or in manufactured articles; in timber, pitch, tar, cordage, and sometimes salted fish. As the river is not more than twelve feet in depth, the larger ships are compelled to take in and discharge their cargoes a little below the city. Long. 16. 5. 24. E. Lat. 58. 36. 5. N.

NORRLAND, one of the provinces of Sweden, which extends in north latitude from 62. 28. to 64. 25. and in east longitude from 14. 41. to 15. 40. being 1078 square miles in extent. It is divided into three bailiwicks, and contains only two towns, with a great number of detached rural establishments. The number of inhabitants does not exceed 61,000. The capital is Hernosand, a city of 1850 inhabitants. In regard to prospects, it is one of the most picturesque in that romantic kingdom, presenting naked rocks rising to 1800 feet amongst lakes, rivers, and woods. The chief products, besides corn, which is scantily grown, are deals and tar, with some iron. The principal branch of industry is making linen, which is spun by both sexes during the long nights of winter.

NORTH, one of the four cardinal points of the world, being that point of the horizon which is directly opposite to the sun in meridian. The north wind is generally accompanied with a considerable degree of cold, and sometimes blows with almost irresistible fury. It is often mentioned by the classical authors under the name of *Boreas*, which is of Greek origin.

North, *Dudley, Lord*, the third baron of that accomplished family. He was one of the finest gentlemen in the court of King James; but in supporting that character he dissipated and gambled away the greater part of his fortune. In 1645 he appears to have acted with the parliament; and by them he was appointed administrator of the admiralty, in conjunction with the Earls of Northumberland, Essex, Warwick, and others. He lived to the age of eighty-five; passed the latter part of his life in retirement; and wrote a small folio of miscellanies, in prose and verse, entitled a Forest Promiscuous of several Seasons' Productions, in four parts, 1659.

North, *Dudley, Lord*, son of the preceding, was made knight of the Bath in 1616, when Charles was created Prince of Wales, and sat in many parliaments, till excluded by the prevailing party in the last, which condemned the king. From that period Lord North lived privately in the country, and towards the end of his life entertained himself with books, but, as his numerous issue required, with economy. He wrote a little tract, called Observations and Advices Economical, 12mo. His other works are, 1. Passages relating to the Long Parliament; 2. the History of the Life of Lord Edward North, the first baron of the family, addressed to his eldest son; and, 3. a volume of Essays.

North, *Francis, Lord Guildford*, lord-keeper of the great seal in the reigns of Charles II. and James II. was a third son of the second Dudley Lord North, baron of Kertling, and studied at St John's College, Cambridge, whence he removed to the Middle Temple. He acquired French, Italian, Spanish, and Dutch, and became not only a good lawyer, but thoroughly conversant with history, mathematics, philosophy, and music. He was afterwards made the king's solicitor-general, and chosen to represent the borough of Lynn in parliament. He succeeded Sir Heneage Finch in the office of attorney-general; and Lord Chief Justice Vaughan, in that of lord chief justice of the Common Pleas. He was afterwards made keeper of the great seal, and in 1683 was created a baron by the title of Lord Guildford. He died at his house at Wroxton in the year 1685. Lord Guildford wrote a philosophical essay on music; a paper on the gravitation of fluids in the bladders of fishes, printed in Lowthorp's Abridgement of the Philosophical Transactions; and some other pieces.

North, *Frederick*, Earl of Guildford, Lord North, lord warden and admiral of the Cinque Ports, governor of Dover Castle, lord lieutenant and custos rotulorum of Somersetshire, chancellor of the university of Oxford, recorder of Gloucester and Taunton, an elder brother of the Trinity House, president of the Foundling Hospital and of the Asylum, a governor of the Turkey Company and of the Charter House, was born on the 13th of April 1732. On the 20th of May 1756, he married Miss Ann Speke, an heiress of the ancient family of Dillington in Somersetshire, by whom he left two sons and three daughters. His lordship succeeded the celebrated Charles Townsend as manager of the House of Commons and Chancellor of the Exchequer; and, in 1770, on the resignation of the Duke of Grafton, was made First Lord of the Treasury, in which office he continued until the close of the American war, or rather until the formation of the Rockingham ministry, which began the business of peace with the colonies. He was a man of strong mental faculties, and an orator of very considerable powers, enlivened and recommended by much pleasantry and amenity; but taking the helm at a time when the king's party were unpopular, and when it was supposed that the Earl of Bute was the great engine by which the cabinet was moved, he continued in a state of great unpopularity until he resigned the seals. During the whole of his premiership, he studiously avoided imposing any taxes which could materially affect the lower class of people. The luxuries and not the necessaries of life were repeated objects of his budget. As a financier he stood high, even in the opinion of an opposition forming a combination of all the great talents in the kingdom; but being fatally wedded to the destructive plan of subduing the republican spirit of the Americans, his administration is marked by an immense waste of the public treasure, and a lavish expenditure of blood. The very last time he spoke in the senate, however, he defended that war, and said he was then, as he had formerly been, prepared to meet the minutest investigation as to his conduct in that contest, which nothing but the unforeseen intervention of France could have prevented from being crowned with success. His lordship was one of the firmest and most strenuous supporters of the constitution in church and state. He died on the 5th of August 1792.

North Cape, the most northerly promontory in Europe, situated on the coast of Norway. Long. 21. 0. E. Lat. 78. 0. N.

North Foreland, a cape or promontory of Kent, in the Isle of Thanet, four miles east of Margate. Between this and the South Foreland are the Downs, through which pass all ships bound to or from the west. Long. 1. 25. E. Lat. 51. 25. N.

North Island, a small island in the Eastern Seas, near the east entrance of the Straits of Sunda, where those who go ashore for wood or water are in great danger from the treacherous Malays, who surprise and murder them. Lat. 5. 57. S. There are four other islands of this name in the Eastern Seas, namely, one near the west coast of Borneo, longitude 109. 5. east, latitude 1. 22. south; another near the north coast of Celebes, longitude 120. 48. east, latitude 5. 38. south; a third, a small island near the south-west coast of the island of Bouton, longitude 122. 50. east, latitude 5. 33. south; and a fourth, an island on the north coast of New Holland, near the head of the Gulf of Carpentaria, included by Captain Flinders under the general appellation of Sir Edward Pellew's Group. Long. of Pellew Cape, the northern extremity of the island, 137. 2. E. Lat. 16. 30½. S.

North Point Isles, several small islands near the north-east coast of New Holland, in latitude 22. S.

North Point Islet, a small island on the north coast of New Holland, in the Gulf of Carpentaria, near the island of Groote Eylandt. Long. 136. 45. E. Lat. 13. 37. S.

North Rocks, otherwise called St Patrick's Rocks, from a seat of stone amongst them called St Patrick's Chair, whence the rocks have taken this second name, are situated in the harbour of Donaghadee, in the county of Down, and province of Ulster, in Ireland. From north to south they are about two thirds of a league, between which is clear good ground. But care must be taken to avoid the south rock, on which many ships have perished; for it is overflowed by every tide, and no crew can save their lives if the wind blows high. This rock stands fully a mile from the shore.

NORTHALLERTON, a borough, market-town, and parish, in the north riding of the county of York, 225 miles north-north-west from London. It is situated on the side of an eminence, which, rising from the banks of a branch of the river Swale, called the Wiske, slopes gently towards the east, and consists chiefly of one broad street about half a mile in length. It is surrounded by an exceedingly rich and fertile tract of country, the parish alone containing 13,000 acres of land. The market-place is spacious, and is surrounded by commodious houses, built principally of brick. The town was formerly celebrated for its fine ales; its chief manufactures at the present time are those of leather and linen. The church is a handsome Gothic structure, built in the form of a cross, and containing several fine old monuments. There is likewise a grammar school, of ancient but uncertain foundation. A new prison was erected, as a relief to the county jail of York, several years ago, according to a plan of Howard. Here was formerly a castle, as well as a convent for nuns; but no vestige of either now remains. This town has a weekly market on the Wednesdays, and five fairs are held during the year. At a short distance from the town was fought the celebrated battle of the Standard, in the year 1138, between the English and the Scots, when the latter were defeated. The government of the borough is vested in a bailiff, deputed by the Bishop of Durham, who is lord of the manor; and it returns two members to parliament. The population of the parish amounted in 1821 to 4431, and in 1831 to 5118; that of the borough amounted in 1821 to 2626, and in 1831 to 3004.

NORTHAMPTON, a borough and capital town of the county of the same name, sixty-six miles north from London. It is situated on a gentle elevation, on the northern bank of the river Nen. The borough, which is of very old standing, extends from the north to the south upwards of two miles, and from east to west about one mile and a half. These limits contain the parishes of All-Saints, St Sepulchre, St Peter, St Giles, and certain extra parochial places. At an early period it was deemed worthy of being a royal residence. The castle then erected for this purpose was built at the west side of the town, upon an eminence, under which the river runs, and traces of the remains are still to be found. Parliaments were repeatedly held here in the reigns of the first Edwards. The town was formerly surrounded by a wall, and contained several monastic institutions; but these decayed through time, or were destroyed at the Reformation, or by the fire in 1675, when the town was nearly burned to the ground. An act of parliament was passed for the rebuilding of the town; and from the funds raised by subscription, as well as from the aid bestowed by the king, the damage occasioned by the disaster was entirely repaired. The town may be said to be nearly divided into four equal parts, by two streets running in the direction of the cardinal points, whilst various other by-streets extend through the town. Both of these streets are wide and spacious, and each extends nearly a mile in length; the limits of the burgh, as has already been mentioned, extend farther. The street called the Drapery, though not the largest, is the finest in the town, both for its breadth and the handsome appearance of its shops. At the south end of the Drapery, and the west end of St Giles, is the market-place, 600 feet square, surrounded by handsome shops and neat private dwellings, and said to be one of the

Northampton. handsomest market-places in Europe. The town is clean, and most of the houses are built of a reddish coloured stone dug in the neighbourhood; the others are of brick. With the exception of the Drapery and other principal streets, the houses present an uniform appearance, and are almost entirely occupied by journeymen shoemakers and other workmen employed in that trade. A great increase of houses of this description has taken place during the last few years. The principal building ground still unoccupied lies in the parishes of St Giles and St Sepulchre; but very active measures are now in progress to open new streets, and extend buildings upon it in every direction. The borough is evidently in a flourishing condition. The inhabitants are chiefly engaged in the shoe, leather, stocking, and thread-lace manufactures. The principal manufacture, however, consists in that of boots and shoes, which has thriven and increased during the last thirty years, without being affected by the various changes which have occurred during that period. The present wages paid weekly to the journeymen amount to L.2000. Great quantities of the shoes and boots are sent to London, as well as exported. This is greatly promoted by the Northampton Canal, which, uniting with the Grand Junction Canal, gives water communication to the principal manufacturing and mining districts, the ports of London, Liverpool, Bristol, and Hull. There are also three well-employed iron-founderies in the town. The town formerly had seven churches within the walls, and two without, but there are now only four in all. The principal church, All Saints, stands nearly in the centre of the town, at the junction of the four leading streets; it is a handsome building, with a fine portico of eight Ionic columns, and is surmounted by a statue of Charles II. The church of St Sepulchre is of a circular form. St Peter's deserves notice only as a relic of ancient architecture. St Giles has nothing remarkable. There are likewise places of worship for Presbyterians, Quakers, Methodists, Baptists, and Roman Catholics. We may add, that there are various charitable institutions for education and the support of the poor. On the eastern side of the town, in an airy and salubrious situation, is the infirmary. The town-hall, county-hall, county jail, town jail, and theatre, are all respectable buildings. The town is lighted with gas. The horse fair held here is considered as the best in the kingdom for saddle and carriage horses. The town is divided into three wards, and is governed by a corporate body, consisting of a mayor, six aldermen, eighteen councillors, twelve justices of the peace, a recorder, and town-clerk. Northampton returns two members to parliament; the number of voters is about 1800, and the returning officer is the mayor. The market-days are Wednesday and Saturday. The population amounted in 1801 to 7220, in 1811 to 8427, in 1821 to 10,844, and in 1831 to 15,351.

Northampton, a post-town and shire-town of Hampshire county, Massachusetts, one of the United States of North America. It is beautifully situated on the west bank of the Connecticut River, ninety-five miles west from Boston. It consists chiefly of two streets, proceeding like the radii of a circle, although with many irregularities. It contains several handsome public buildings, of which the court-house, jail, and one of the religious meeting-houses, are the most conspicuous. The private houses are in general large, and in a good style, and many of them are elegant. Northampton is a place greatly resorted to by travellers, from the romantic beauty of the scenery in the vicinity. The common schools of this place are highly respectable. A stream passes near the centre of the town, on which are erected numerous mills and many manufactories, amongst which are two of woollen. Farmington Canal extends from New Haven to this place. A bridge, built in 1826, connecting this town and Hadley, is 1086 feet in length by thirty-six in breadth, and is supported by six piers and two abutments. The Indians called this town Nonatuck. It was the third place settled on the river in this state, and was incorporated in 1654. Amongst the striking objects in the scenery of Northampton are the beautiful river, and the heights called Mount Tom and Mount Holyoke, the former being 1200 and the latter 900 feet above the river. The population amounted in 1830 to 3618. Long. 72. 40. W. Lat. 42. 16. N.

Northamptonshire. NORTHAMPTONSHIRE, an inland county of England, nearly in the centre of the kingdom. It is of an irregular and very extended figure, being about sixty-seven miles in length. In the widest part it is thirty miles, and in the narrowest not more than eight miles in breadth. The extent, according to the returns collected by Mr Rickman, is 646,810 acres. The land is thus appropriated:—About 290,000 acres are in arable cultivation, 235,000 acres are in pasture, and about 86,000 are uncultivated, or occupied as forests and woodlands. The county contains one city, eleven market-towns, 301 parishes, and is divided into 1901 liberties.

The population, according to the official returns at the four decennial enumerations, amounted in 1801 to 131,757, in 1811 to 141,353, in 1821 to 162,483, and in 1831 to 179,300. The annual value of the whole real property of the county, as taken in the year 1815 for the purposes of the property-tax, was L.942,162. The burials, including both the registered and the unregistered, in the ten years from 1821 to 1831, appear to have been about one in fifty of the whole number of inhabitants then living. The illegitimate births were one in twenty-five of the whole number born.

The occupations of the people, according to the returns arranged by Mr Rickman in 1831, were as follow:

Occupiers of land employing labourers	3,015
Occupiers of land not employing labourers	1,117
Employed in retail trades or handicraft	13,841
Capitalists, bankers, and professional men	1,264
Labourers not agricultural	2,619
Other males under twenty years of age	2,874
Male servants under twenty years of age	417
Ditto above twenty years of age	706
Female servants	5,678

From its oblong shape, lying obliquely across the middle of the kingdom, Northamptonshire comes in contact with, and is bounded by, a greater number of other counties than any other division of England. Proceeding from the north, on its western side, it touches upon Lincolnshire, Rutlandshire, Leicestershire, Warwickshire, and Oxfordshire; and on its eastern side it is bounded by Buckinghamshire, Bedfordshire, Huntingdonshire, and Cambridgeshire. The whole of the county is within the diocese of Peterborough, with the exception of three parishes which are included in the see of Lincoln.

Northamptonshire is generally a pleasant country, with such undulations as give an agreeable variety; but, owing to the numerous enclosures, the prospects are not in general extensive, except upon the summits of the higher hills. The centre of the county is a level elevation, from which the rivers have their rise, and, descending in opposite directions, take a course both to the German Ocean and the English Channel.

The agriculture of this county partakes so much of the nature of the several counties that border on it, as to be almost as various, and not to merit any particular description. The most important rural pursuit is the grazing of cattle, for which the excellent pastures are admirably adapted. The cattle, when fattened, are sent in weekly droves to the market of Smithfield for the supply of the metropolis, where they are highly esteemed. The arable land produces excellent wheat, beans, and oats; but the soil in general is not well calculated to raise good barley. The artificial grasses, clover, trefoil, sainfoin, and rye-grass, are very extensively cultivated, and, aided by turnips, form important articles of food for the flocks and herds.

Within this county there are several large forests belonging to the crown, with two chases, over which the king has certain rights. The largest of these is the Forest of Rockingham, in the northern part of the county, extending over 11,000 acres. The land, in many instances, belongs to individuals; but the royal deer have, under certain restrictions, the range over the whole. Whittlewood Forest contains about 5000 acres. It is stocked with about 1000 deer; a proportion of which, according to ancient prescription, are killed annually for the royal household, and for the great officers of the government, who receive them as a matter of right attached to their appointments. This forest contains much excellent naval timber, which is reserved for the use of the government; but, from the reports of the commissioners, it appears to be very negligently preserved, and very injudiciously managed. Salcey Forest is about 1850 acres in extent. This tract was formerly covered with most valuable ship-timber, but has furnished for the navy only a very small proportion of what it is capable of. The mixture of opposite interests in this kind of property diminishes its productiveness to all the parties interested in it. The underwood does not belong to the crown. The individuals who own it cut it down every twenty-one years. During the following nine years it is enclosed, and for the remaining twelve it is open for the deer to feed on the land. The crown enjoys only this right of pasture and the timber trees. The pasture does not belong exclusively to it, for many of the surrounding parishes possess also a right to turn their cattle into the forests, under ancient grants and prescriptions, and with limitations of a complex nature, which are productive of perpetual dissensions and litigations. The rangership of these forests is hereditary in the Dukes of Grafton, who have, during the last century, derived from it a very large income, whilst the revenue to the crown has been very trifling, scarcely amounting to L.200 per annum upon an average of the last hundred years.

The only navigable river in this county is the Nen or Nine. It rises in the western part, flows across, and then runs north, till it enters by Lincolnshire into the German Ocean. The Welland rises in the county, then forms the boundary between it and Leicestershire and Rutlandshire, and only becomes navigable after entering Lincolnshire at Stamford. The other rivers, the Ouse, the Avon, the Leam, and the Charwell, although they have their sources in Northamptonshire, are but inconsiderable rivulets till they enter the contiguous counties. The benefits of internal navigation have been very freely bestowed here by the canals, which afford great facilities to internal intercourse. The Oxford Canal connects it with that city. The Grand Junction Canal, communicating on one hand with London, and on the other with Liverpool and Manchester, passes through this county. The Grand Union Canal connects it with Leicester. Thus the heavy products, especially coals, are brought to every part on very moderate terms. Great advantage to this county is anticipated from that great work, now hastening to its completion, the London and Birmingham Railway, which will enter it near Stony Stratford, and proceed more than thirty miles, when it will advance through a corner of Leicestershire to Warwickshire.

The remains of Roman and Saxon antiquities are very numerous. Amongst the former, the Watling Street Road, the Ermine Street Road, the camps of Arbury, of the Boroughs, and of Rainsbury, and the tesselated pavements at Cotterstock, at Stanwick, and at Woodford Field, have engaged the attention of Stukely and other eminent antiquaries. As there were more than sixty monasteries and other religious houses at the period of the Reformation, traces of which may still be seen, they, with the baronial castles, present a wide field for the researches of the lovers of antiquity; but the bare enumeration of them would be incompatible with the limits of this work.

The manufactures of this county are chiefly of a domestic nature, and carried on in the dwellings of the workmen. Boots and shoes are made for foreign markets, and, in war, for the supply of the army. Both fine thread and silk lace are made, and afford employment to the females, who are taught the art in schools for that purpose, and attain great perfection. The principal places for collecting the lace are Northampton and Wellingborough. A large quantity of horse-whips were made at Daventry, and, though diminished in some degree, the trade is still continued there.

The titles derived from this county are Duke of Grafton; Marquis of Northampton; Earls of Peterborough, Fitzwilliam, Spencer, and Harrington; Viscount Sackville; Barons Braybrooke and Lilford; and as second titles, Baron Burleigh to the Marquis of Exeter, Viscount Milton to Earl Fitzwilliam, Viscount Brackley to the Earl of Bridgewater, and Baron Finch to the Earl of Winchelsea. By the reform act this county is formed, for the purpose of electing members of parliament, into two divisions, distinguished into North and South, each returning two members. The election for the northern division is held at Kettering, and the polling places are, that town, Peterborough, Oundle, Wellingborough, and Clipston. The election for the southern is held at Northampton, and, besides that town, at Daventry, Towcester, and Brackley. The boroughs of Brackley and Higham Ferrers were by the same law disfranchised.

The most celebrated natives of Northamptonshire have been, Robert Browne, the founder of the sect of Independents; Mrs Chapone; John Dryden, the poet; Fletcher, the dramatist; Fuller, the historian and divine; Harrington, author of the *Oceana;* Hervey, author of Meditations and other works; Knolles, the historian of the Turks; Dr William Paley; Bishop Wilkins; and Thomas Woolston.

The catalogue of all the noblemen and gentlemen's seats in this county would extend to a long list, and we therefore can only notice the most remarkable of them, viz. Castle Ashby, Marquis of Northampton; Aldwinckle, Lady Lilford; Althorp, Earl Spencer; Apethorpe, Earl of Westmoreland; Brinworth, Walter Strickland, Esq.; Burleigh, Marquis of Exeter; Canons Ashby, Sir J. E. Dryden; Cottesbroke, Sir James Lanham; Courteen Hall, Sir William Wake; Dean, Earl of Cardigan; Drayton, Duke of Dorset; Easton Neston, Earl Pomfret; Ecton, Samuel Isled, Esq.; Fawsley Park, Sir Charles Knightley; Finedon Hall, Sir William Dolben; Horton, Sir Robert Gunning; Kirby, George Finch Hatton, Esq; Lamport, Sir Justinian Isham; Lilford, Lord Lilford; Martin's Thorpe, Earl of Denbigh; Milton Abbey, Earl Fitzwilliam; Rockingham Castle, Lord Sondes; Salcey Forest, Earl Euston; Wakefield Lawn, Duke of Grafton; Walgrave, Sir James Langham; Whittlebury, Lord Southampton.

The towns having a population exceeding 1400 are the following:

Northampton	15,351	Brackley	2,107
Peterborough	5,553	Buckby, Long	2,078
Wellingborough	4,688	Rothwell	2,002
Kettering	4,099	Paulers Pury	1,544
Daventry	3,646	Weedon	1,439
Towcester	2,671	Middleton Cheyney	1,415
Oundle	2,450		

NORTHCOTE, James, a distinguished English painter, was born at Plymouth in the year 1746. He evinced a predilection for the arts at a very early period, but received no encouragement from his father, who was an eminent

Northcote. watchmaker, and apprenticed him to his own trade. When the period of his indenture had expired, the strong bent of young Northcote's genius prevailed; and being fortunate enough to obtain a recommendation to Sir Joshua Reynolds, that eminent artist received him as a pupil. Northcote had nearly reached his twenty-fifth year when he arrived in London; and having had comparatively little experience in painting previously to this period, his attainments were greatly inferior to those of other beginners much younger than himself. It was therefore with no great reliance on his talents that Sir Joshua gave him a trial; but diligence and native genius soon made amends for all deficiencies, and, much to the satisfaction of his master, with whom he became a favourite pupil, his improvement was rapid. He was also of an age to be a pleasant companion to Sir Joshua; and from his great natural talents, and extraordinary powers of conversation, he was enabled to avail himself of all the advantages of that polished society which assembled in the house of his master. Northcote remained domesticated for five years, on the most agreeable terms, in Sir Joshua's family; and in 1776 he reluctantly quitted an abode which had in every way been rendered delightful to him. He commenced portrait painter, in which he would doubtless have attained great eminence; but his powerful intellect was scarcely satisfied with this limited branch of art, and he resolved to prosecute the more independent and pleasing, although much less lucrative, study of historical painting. In furtherance of this object, he, in 1777, repaired to Italy, where he remained three years, devoting his time alternately to the study of the great masters, and to original compositions. During his sojourn on the Continent, he was elected a member of the Imperial Academy at Florence, of the ancient Etruscan Academy at Cortona, and of the Accademia delle Arti at Rome. He was also requested to execute a portrait of himself, to be placed amongst those of distinguished artists which grace the gallery at Florence; and the picture which he presented is at once a faithful resemblance and an exquisite specimen of his professional skill.

On his return to England, Northcote pursued the study of design with all the ardour of an artist; and it was soon apparent that he had not mistaken his forte or miscalculated his powers. About this period Mr Boydell was engaged in procuring engravings from pictures by the old masters, whose works he had either obtained the use of, or had caused to be copied by skilful hands. His next experiment was to commission native artists of distinction to paint original composition from history and other subjects, and to cause these also to be engraved by Englishmen. Northcote being one of the most promising painters of the British school, was employed by Mr Boydell, and also by other printsellers; and prints from his designs were to be seen, framed and glazed, upon the walls of the higher order of dwellings in every part of the kingdom. One of the most admired, entitled the Village Doctress, had for several years a considerable sale. It was not, however, until the Shakspeare Gallery was opened, that the world was made fully aware of the powers of Northcote. Amongst the many splendid efforts of British art which were thus collected together, none proved more attractive than his compositions. The scene of the smothering of the young princes in the Tower of London; that of removing their bodies secretly by torch-light for interment at the foot of the stone steps; the subject of Arthur and Hubert; the entrance into London of Richard II. and Bolingbroke, and others from his pencil, are undoubtedly to be reckoned amongst the best specimens of British art at this flourishing period of its history. These productions clearly proved how well he had studied the works of his illustrious master, and imbibed his feelings as a colourist. Northcote had now attained the zenith of his fame; and he received the reward of his abilities by being elected an associate of the Royal Academy on the 6th of November 1786, and a royal academician on the 13th of February 1787.

From this period Northcote divided his professional labours between historical compositions, fancy subjects, and portraiture. The dramatic style, however, attracted his attention for a time, and he painted a series of moral subjects, illustrative of virtue and vice, in the progress of two young women. This was trenching upon the ground of Hogarth, and the attempt proved a failure; for although the main points of this graphic drama bore directly upon the subject, the characters were deficient in expression and individuality. In painting, Northcote kept the colouring of Sir Joshua Reynolds steadily in his eye; and so little change in his style had his contemplation of the great masters in Italy wrought, that no one could discover the least approach to that severity of manner which is peculiar to the Roman and other Italian masters. His pictures are distinguished for their breadth of light and shade; and most of his historical works display a comprehensive and accurate knowledge of the subject, much study, and considerable force of conception. For a period of above thirty years his productions may be said to have borne a conspicuous part in the exhibitions at Somerset House; and, to the last year of his life, a season seldom elapsed without his presenting one or more efforts of his pencil at the British Institution or the Gallery of the British Artists.

That Northcote was an enthusiast in his art may be gathered from many anecdotes related of him whilst expatiating upon the merits of the great masters. A favourite pursuit of his was the painting of wild animals; and one day, whilst making a study from nature of a vulture, he laid down his palette, and clasping his hands, exclaimed, "I lately beheld an eagle painted by Titian, and if heaven would give me the power to achieve such a work, I would then be content to die." His conversational powers have been extolled by all who had an opportunity of knowing him; but he never allowed the fascinations of society to interfere with his professional avocations. It was his custom for many years to take an early morning walk, on his return from which he breakfasted, and then went to his studio. About eleven in the forenoon, unless he had an engagement with a sitter, his levee commenced. It seldom happened that he remained alone; one visitor succeeding another, and occasionally three or four at a time, holding him in conversation until the hour for dinner. All the while he was proceeding with whatever picture he had on hand, working and talking at the same time. His conversation was distinguished by sagacity, acuteness, and great extent of information, as may be seen from a volume published by Mr Hazlitt, entitled Conversations with the late James Northcote, R. A. He had, however, much of that cynical spirit too prevalent amongst artists, of depreciating the works and characters of their rivals; but he was benevolent withal, and whatever he might say in disparagement of those who crossed his path, he was ever ready to befriend those who applied to him for assistance or advice. To young artists he was kind and condescending, and always easily accessible. Such traits in the pictures or drawings which they submitted to him as happened to display originality and talent, gave him delight; for he felt a patriotic pride in the arts of his country, and a personal interest in their advancement. In whatever company Northcote might be, he always maintained his opinions, which were often singular, with a manly independence, which secured him general respect. One day a royal duke, whilst attending at a sitting of Master Betty, the young Roscius, whom Northcote, with his usual sagacity, thoroughly despised, used some liberties with the artist's gray locks, observing, "You do not devote much time to the toilet, I perceive?" Northcote instantly replied, "Sir, I never allow any one to take personal liberties with me; you are the first who ever presumed to do so, and I beg your royal highness to recollect that I am in my own house." He then resumed his painting, and the royal personage, feeling the rebuke, shortly afterwards took his departure. Next day, however, the artist was surprised by a visit from his royal highness, who, in returning something of which he had obtained the loan, handsomely apologised to him for the liberty which had been thoughtlessly taken.

Northcote was naturally just, temperate, careful, and in the strictest sense of the word a philosopher. The system of life which he early prescribed for himself was founded on wisdom, and maintained with constancy. The frugal manner in which his table was served from principle might lead to the idea that he was parsimonious; but this is rendered nugatory by the facts, that he lent money freely without asking for interest, and sometimes not even for the principal, by which means he frequently lost it; that he was the most patient and long-suffering of creditors, not only feeling a horror at asking for what was justly due him for his works, but often having whole-lengths, half-lengths, and bust portraits thrown upon his hands without his ever attempting to enforce payment. His prudence and foresight, however, enabled him to secure an independence for the evening of life, which so often overtakes artists in destitution and misery. The last years of Northcote's life were spent in preparing for the press a volume of fables and a Life of Titian. He died on the 13th of July 1831, and his remains were deposited in the church of St Mary-le-Bone on the 20th of the same month.

Northcote was an author as well as a painter. His earliest productions were some papers inserted in a periodical work called The Artist. The subjects of these papers were, Originality in Painting, Imitators and Collectors, Disappointed Genius, a Character of John Opie, Letter from a Disappointed Genius, and the Imitation of the Stage in Painting. In the second volume of the same work, the History of the Slighted Beauty, an allegory, was also by him. He further contributed to the fine arts of the English school the biography of Sir Joshua Reynolds, which he afterwards expanded into a quarto volume, entitled Memoirs of Sir Joshua Reynolds, comprising anecdotes of many distinguished persons, his contemporaries, and a brief analysis of his Discourses; to which are added, Varieties on Art, 1813. A supplement to the work appeared in 1815; and an octavo edition, with considerable additions, came out in 1819. In 1828 he published, in octavo, One Hundred Fables, original and selected, embellished with two hundred and eighty engravings on wood from his own designs. He likewise left materials for a second series, which by directions given in his will was to be published after the death of his sister. His last work, which appeared at the close of the year 1830, in two volumes octavo, is the Life of Titian, with anecdotes of the distinguished persons of his time; a work containing a vast mass of useful information and reflection on the art of painting. (R. R. R.)

NORTHERN LIGHTS, the same with the Aurora Borealis. See Aurora Borealis.

NORTHFLEET, a town of the county of Kent, in the hundred of Toltingtrough, and lathe of Aylesford, twenty miles from London, on the road to Dover. It is situated on a chalk hill rising from the south bank of the Thames, and commanding an extensive view of the river, and of the county of Essex beyond it. Great quantities of lime are made from chalk, and the flints collected are prepared for fire-arms. Northfleet has now no market. The population amounted in 1801 to 1910, in 1811 to 2031, in 1821 to 1964, and in 1831 to 2124.

NORTHLEACH, a town of the county of Gloucester, in the hundred of Bradley, eighty-one miles from London. It is situated in the centre of the range of the Cotswold Hills, on the river Leach, and was once a clothing town of some consideration, but that trade is lost. There is here a bridewell for the county, and a free grammar-school. It is a corporate town, and has a market which is held on Wednesday. The population amounted in 1801 to 664, in 1811 to 647, in 1821 to 773, and in 1831 to 795.

Northumberland.

NORTHUMBERLAND, an extensive county in England, situated on its northern extremity, upon the borders of Scotland, from which it is separated partly by the river Tweed, which, during the latter part of its course, flows between this county and Berwickshire, and partly by a line supposed to be drawn over the mountainous region on the west and north-west, where it meets with Roxburghshire. The other boundaries are the German Ocean on the east, Durham on the south, Cumberland on the west, and on the north two small districts called Norhamshire and Islandshire, which, though belonging by their situation to Northumberland, form a part of the county of Durham, along with another tract called Bedlingtonshire, on the south-east. But in a general description it is unnecessary to attend to these distinctions. The Tweed may, therefore, be considered as the northern boundary of the county, and in this case it will include the towns of Berwick and Norham. Lindisfarne or Holy Island, on the north-east coast, which in like manner belongs to Durham, is situated about two miles from the mainland, opposite to the mouth of the brook Lindis, and accessible to all kinds of conveyance at low water. Although about nine miles in circuit, it contains little more than 1000 acres, the half of which is sand-banks. These several portions may extend to something more than 100 square miles, or about one twentieth part of the whole. In this view, Northumberland is situated between 54. 51. and 55. 48. north latitude, and between 1. and 2. 27. west longitude from London. Its greatest extent from north to south is sixty-four miles, and from east to west it varies from about forty-six miles, which is its usual breadth between the river Tyne on the south and the Coquet on the north, till it terminates at the town of Berwick on the north, in a breadth of only five or six miles. According to Mr Rickman's Report of 1831, the area of the county is 1871 square miles, or 1,197,000 acres; but the actual returns from the parishes give only 1,165,430 acres, a difference which is supposed to arise from the inaccurate measurement of the mountainous and uncultivated part of the western division of the county. Nearly one third of the county is scarcely capable of beneficial cultivation.

It is divided into six wards, namely, Tindale, Coquetdale, Glendale, Bamborough, Morpeth, and Castle, the first three comprising the western and mountainous district, and the second three the coast lands on the east. These last, though extending over only one fourth of the county, are by far the most wealthy and populous, owing chiefly to the great coal-works in Castle ward, near the town of Newcastle, and along the banks of the Tyne. It contains five deaneries and seventy-three parishes, all of which are in the archdeaconry of Northumberland and diocese of Durham.

All the western side of this county is mountainous, from the common boundary with Durham on the south, almost to the valley of the Tweed on the north; but this extensive tract, comprising more than a third of the whole area, is not all of the same character; the northern, or Cheviot Hills, extending to about 90,000 acres, being mostly all green nearly to their summits, comprehending many narrow but fertile glens, and affording excellent pastures for the breed of sheep to which they have given their name; whilst those to the west and south are, in general, open solitary wastes, covered with heath, and of very little value. On the coast, from the mouth of the Tyne to that of the Tweed, and also on the north, throughout its whole breadth

Northumberland.

from Belford to Mindrum, the country is, with few exceptions, level and rich, with a soil which in some places is a strong clay, and in others a dry loam, but almost everywhere very productive, under the enlightened system of cultivation which prevails so generally throughout Northumberland.

The principal rivers of the county are the Tyne, Blyth, Wansbeck, Coquet, Aln, and the Tweed, all of which fall into the sea, carrying with them the tribute of many smaller streams. The Till, which empties itself into the Tweed, is also a considerable rivulet. The Tyne and Tweed are by far the most important, the tide flowing up the former sixteen miles, and up the latter eight or ten miles; whilst the navigation of the other rivers is confined to a small distance from their mouths. Both of these have long been celebrated for their salmon fisheries, which yield great rents, and afford a valuable article of trade with London, to which the fish are sent packed in pounded ice, by which means they are presented in the market in nearly as fresh a state as if they had been newly taken from the water.

Northumberland has been long distinguished for its subterranean treasures, which are the main source of its wealth and population. Of these, coal, which abounds in most parts of it, is by far the most important. It is of the best quality in the south-eastern quarter, on the banks of the Tyne, whence those vast quantities are exported which supply the great consumption of the metropolis, as well as the coasting and foreign trade. In some years the exportation from the port of Newcastle has amounted to upwards of 600,000 chaldrons of fifty-three cwt. each, and probably, as much more has been sent from Sunderland and consumed in Northumberland and Durham, the same coal-field extending across the Tyne to the latter county. This coal is all of the kind called "caking coal," which melts and runs together in the fire, and, when of the best quality, leaves very few ashes. Calculations have been made as to the extent of this tract, the quantity of coal which it may contain, and the period when it must be exhausted; but upon this last point there is a great difference of opinion, some estimating that the supplies must cease in three hundred years, some not in less than eight hundred, whilst by others it is held to be almost inexhaustible. Of the coal found in Bamborough, Islandshire, and Glendale ward, the seams are in general thin, and the quality inferior, not caking nor burning to a cinder, but yielding a great quantity of ashes. This is used only for home consumption and for burning limestone, a purpose for which it is well adapted; and through all this district coal and lime are generally found together. The south-eastern quarter, which is so rich in coal, is destitute of limestone. Lead ore abounds in the mountains on the south-west, particularly towards the head of that branch of South Tyne called Allendale, where it has long been wrought to a considerable extent. Iron ore is found in many parts; stone marl near Tweedside, shell marl in Glendale ward, and various sorts of sandstone or freestone are obtained in almost every quarter, some of it affording tolerable slates for roofing, and flags for floors. Excellent grindstones are raised in the sandstone quarries, of which a great many are exported from Camus and Warkworth.

The agriculture of Northumberland is an object which is only second in interest and importance to its coal works. Almost all those branches of rural economy for one or more of which other districts are celebrated, may here be found combined into one system, and conducted upon the same farms. One finds here the Leicester sheep and the short-horned cattle of Durham and Yorkshire, both in great perfection; the turnips of Norfolk cultivated upon the drill system of Scotland; the well-dressed fallows of East Lothian and Berwickshire; and that regular alternation of tillage and grazing which is, of all other courses of cropping, the one best adapted to sustain and even to improve the productiveness of the soil. These remarks apply in an especial manner to the northern part of the county, where the farms are in general large, and the occupiers men of education and liberal acquirements. This quarter has been long distinguished as a school of agriculture, to which pupils are sent, some of them gentlemen of fortune, from various parts; a character for which it is eminently indebted, as well as for other distinctions, to the late Messrs Culley, who were amongst the most extensive and successful farmers in the kingdom. The common period of leases, at least in the northern district, is twenty-one years, although many are shorter, and upon a few estates no leases are granted. By the account taken for the purpose of levying the property-tax in the year 1815, it was found that the annual value of the real property amounted to L.1,240,594. It may be worthy of remark here, that at the seat of the Earl of Tankerville, called Chillingham Castle, there still exists in the forest the remains of the herds of wild cattle which are supposed to have formerly abounded in this island, and to have been the origin of our races of cows.

Northumberland is not eminently a manufacturing county. Some wool-combing is carried on at Hexham, and some thread is spun in the villages; but the chief branches of manufacturing industry are those depending upon the cheapness of iron and coal, and are chiefly carried on within and around the town of Newcastle, to which head in this work the reader is referred.

The population of the county at the four decennial enumerations has been as follows:—In 1801 it amounted to 157,101, in 1811 to 172,161, in 1821 to 198,965, and in 1831 to 223,000. The burials, including both the registered and unregistered, in the ten years from 1821 to 1831, appear to have been one in fifty-two of the whole number of inhabitants then living. The illegitimate births were one in fifteen of the whole number born.

The occupations of the people, according to the returns arranged by Mr Rickman, were in 1831 as follows:

Occupiers of land employing labourers	2,376
Occupiers of land not employing labourers	1,268
Employed in retail trade and handicraft	17,149
Capitalists, bankers, and professional men	2,857
Labourers not agricultural	13,930
Employed in manufactures or machinery	1,252
Other males under twenty years of age	3,228
Male servants of all ages	961
Female servants	10,263
Agricultural labourers	10,441

The number of inhabited houses was in 1831........35,726

In these there were 48,364 families, of whom 10,127 were chiefly employed in agriculture, 14,246 in trade or manufactures, and 23,091 belonged to neither of these classes. This county is included in the northern circuit. The assizes are held at Newcastle, and the quarter-sessions successively at Newcastle, Morpeth, Hexham, and Alnwick.

The title of duke of this county belongs to the family of Percy, though now in the female line. The Earl of Carlisle derives his second title from the town of Morpeth. For the purposes of election two divisions are formed, each returning two members. The elections for the northern division are held at Alnwick; and the polling places are, besides that town, Berwick, Elsdon, Morpeth, and Wooler: for the southern they are held at Hexham, and the other polling places are Bellingham, Haltwhistle, Hexham, Newcastle, and Stamfordham. There are two boroughs within the county; Newcastle, which returns two members to the House of Commons; and Morpeth, which also returned two before the reform bill, but at present only one. Berwick, which, though for some purposes a county of itself, may be considered as in Northumberland, returns two members.

The towns containing more than 1500 inhabitants, with their population in 1831, were the following, viz.

Newcastle	42,760	Morpeth	4797
Tynemouth	24,778	Haltwhistle	4119
Berwick	8,920	Ford	2110
Alnwick	6,788	Wooler	1926
North Shields	6,744	Lowick	1864
Long Benton	6,613	Hartley	1850
Hexham	6,042	Blyth	1769
Walls-end	5,510		

The most remarkable of the noblemen and gentlemen's seats are, Alnwick Castle, the Duke of Northumberland; Chillingham Castle, the Earl of Tankerville; Haggerstone Castle, Sir Carneby Haggerstone; Howick House, Earl Grey; Falloden House, General Grey; Bamborough Castle, Lord Crewe; and Barmour Castle, F. Sitwell, Esq.

Northumberland Islands, a chain of islands in the South Pacific Ocean, near the north-eastern coast of New Holland, which runs parallel to the mainland at the distance of from five to eight miles. The largest is about thirteen miles in circumference. Long. 149. 47. to 150. 37. E. Lat. 21. 32. to 22. S.

Northumberland Straits, a narrow channel of the Eastern Seas, between the islands of Calamianes and the shoals of Apo.

North-East Passage, a passage to the East Indies along the northern coast of Asia, which, like the North-West Passage, has frequently been attempted, but hitherto without success. See Polar Seas.

North-West Passage, a supposed passage to the Pacific Ocean through Hudson's Bay or Davis' Straits, and which has frequently been attempted, as yet with only partial success. See the article Polar Seas.

North-West Territory, a vast tract of country in North America, situated between 42. 30. and 49. north latitude, and 87. 30. and 95. 30. west longitude. It is bounded on the north by the British possessions and Lake Superior, on the east by Lake Michigan, on the south by Illinois, and on the west by the Mississippi, and a line drawn from the source of that river to the northern boundary. In length it extends about 500 miles, and in breadth about 400 miles. In some of its physical features this territory resembles that of Missouri; but a greater proportion of it is covered with wood. It is, generally speaking, a hilly country, with the exception of extensive levels of prairie land. At the western extremity of Lake Superior are the Cabotian Mountains; and near the mineral district are the Smoky Mountains. The chief rivers, with the exception of the Mississippi (see the article Mississippi), are the Ouisconsin, Fox, Chippeway, St Croix, Rum, St Francis, and Savannah of the Mississippi. Grand Portage, Ontonagon, Montreal, Mauvaise, Boisbrule, St Louis, and nearly fifty smaller streams, discharge themselves into Lake Superior. Riviere la Pluie falls into the Lake of the Woods. None of the lake rivers have a course of more than a hundred and fifty miles, and few of them more than fifty miles. The Ouisconsin, the largest tributary of the Mississippi in this territory, rises in the northern interior of the country, and interlocks with the Montreal of Lake Superior. It has a course of between three and four hundred miles, with a shallow and rapid current, which is, however, generally navigable by boats in good states of the water, and is 800 yards wide at its mouth. There is a portage of only half a mile between this and Fox River. It extends over a level prairie, across which, from river to river, there is a water communication for periogues in high states of the water. Fox River has a course of 260 miles, flowing through Winnebago Lake, and into the Green Bay of Lake Superior. The country on its banks is very fine, and the climate is salubrious. Another considerable tributary of the Mississippi is the Chippeway, which enters it immediately below Lake Pepin. It is half a mile wide at its mouth, and has communication, by a short portage, with Lake Superior. This is one of the very best regions for hunters. In the upper part of the country, buffaloes, elks, bears, and deer, are common. Beavers, otters, and musk-rats, are taken for their furs. The trappers, and also the Indian tribes, pursue their prey over an immense extent of prairie. The soil is fertile in some parts, and no doubt the enterprise and industry of civilized men will ere long bring a great portion of it under cultivation. White and yellow pine and white birch are common amongst the forest trees. All the water courses, ponds, and marshes, are covered with wild rice, which the inhabitants use as one of their chief articles of food. The elevation of the head waters of the Mississippi is estimated at 1330 feet above the level of the sea.

North-West Territory.

This country abounds in minerals, and rich veins of valuable ore have been discovered and wrought to considerable advantage. Great quantities of *terre verte* or green earth, lead, iron, and copper, are also found in it. The lead-mine district is situated in the lower part of the country, between Rock River and the Ouisconsin. The chief establishments of the present miners are on Fever River, and the mines are reckoned as rich and productive as any in the world. The following are the quantities produced in each year from 1823 to 1832.

Years.	Pounds.	Years.	Pounds.
1823	335,130	1828	11,105,810
1824	175,220	1829	13,343,150
1825	664,530	1830	8,323,998
1826	958,842	1831	6,381,901
1827	5,181,180	1832	4,281,876
Total in ten years			50,752,626 lbs.

The great increase in the years 1828 and 1829 reduced the price so low as to render the working of the mines in a great measure unprofitable. For upwards of half a century it has been confidently asserted that great quantities of native copper may be found along the northern shore of Lake Superior. On the Outogon there is a vast abundance of pure copper in detached masses. One of these masses is estimated to weigh 3000 lbs. The common reports, however, of the existence of large veins of copper, have not been confirmed by recent travellers; but there are nevertheless sufficient indications that mines of this metal are to be met with in this territory. Besides lead, iron is found in various places, and in great abundance.

In the southern portion of this large territory the climate is comparatively mild, and not unlike that of the northern belt of Missouri. At the Falls of St Anthony, on the Mississippi, the summers are temperate, whilst the winters are extremely cold. The sources of the Mississippi are in a region extremely inclement. At St Peters, in 1820, the mean temperature of January was zero, a degree of cold which is never experienced in any part of the United States that has been extensively settled. The summer, however, was temperate, and the atmosphere beautifully serene. Even at Prairie du Chien, although much more temperate, the winters are extremely severe. At the Falls of Packagama, on the Mississippi, about 1200 feet above the level of the sea, water has been known to freeze to a considerable extent in the middle of July. The following table, extracted from the work of an American writer, will convey the best idea of the nature of the climate in different parts of the North-west Territory:

'North-West Territory.

Place.	Date.	Average Temperature.		Prevailing Winds.
		Air.	Water.	
Detroit	May 15 to 24.	60°	0°	North-east.
River St Clair	... 24 to 27.	51	52	North-west.
Lake Huron	... 28 to June 6.	51	51	...
Mackinack	June 7 to 13.	55	0	South-east.
Ditto to Lake Superior	... 13 to 18.	66	0	South-west.
Lake Superior	... 19 to 27.	66	58	North-west.
Ontonagon River	... 28 to 30.	80	73	...
Water of Lake Superior	......	...	66	...
Ontonagon River to Fond du Lac	July 1 to 5.	64	61	South-west.
Between Fond du Lac and Sandy Lake	... 6 to 16.	67	...	North-west.
At Sandy Lake	... 17 to 24.	73	...	...
From Sandy Lake to St Peters	... 25 to Aug. 1.	69	...	South-west.
Chicago	January.	15	...	North-west and south-west.
Ditto	February.	32	...	South-west.
Ditto	March 15.	29	...	North-east.

The North-west Territory is divided, or rather marked off, into four counties, which have been named and partially settled by whites; but there are still a number of Indians in it. Prairie du Chien, Cassville, and Green Bay, are the largest villages; and the whole population has been estimated at 16,000. Green Bay settlement is situated at the outlet of Fox River, and contains 952 inhabitants. A few miles up Fox River, in a most romantic position, there is an interesting Episcopal missionary settlement. Prairie du Chien is of importance as a place of outfit from the Lower Mississippi to the upper waters. It is situated near a beautiful prairie, and there are flour-mills in its vicinity. Most of the permanent settlers here are a mixed race of Indians and whites. Frequent voyages are made from St Louis to Prairie du Chien in keel-boats. The richest copper mines, and the largest masses of pure copper, are said to be found here. One third of the land is capable of being farmed, and about one sixth is well timbered.

The whole of this vast region has been for some time politically connected with Michigan for the sake of convenience, but it must ultimately constitute a state by itself. Most of the lands are owned by Indians, or by the United States; the latter having recently made a purchase from the former of a very considerable tract of country. The following description of the Indian territory is from Flint's Geography: "The tract reserved to the Indians, of 500,000 acres, is also a fine body of land, containing very extensive and fertile meadows along the Fox River, with woodlands of good timber, in which there is no underbrush. The writer proceeded thirty-eight miles from Green Bay, up the Fox River, to Winnebago Lake, passing rapids whose whole descent is about 100 feet. The river is ninety yards wide, its bed a limestone rock, the banks from fifty to 150 feet high. The water is of course adequate to move any machinery. Doty's Island, in the outlet of the lake, contains 400 acres heavily timbered. The bank of the lake itself is covered with trees of a height and diameter indicating the nature of the soil, which is a black loam, rich and deep. The Cliff, so called, is a mountain 300 feet above the level of the lake, presenting a picturesque prospect. The main roads leading from Green Bay to Chicago, Ouisconsin, Portage, the Lead Mines, and Galena, will probably pass this point. Beyond this the mountain recedes three or four miles from the shore, forming a valley fifteen miles in length, of as fertile land as can be found in the United States, terminating to the south in a dry prairie called Cass Plains. These plains contain 25,000 acres of rich land, which are already cleared by nature for the plough, and they extend to the Manitoovoc River. Soon after begin the prairies, which run, with scarcely any timber, to the Mississippi. In the whole distance, near 100 miles, passed by the writer, the land seems to be of the kind and aspect just described, namely, rich prairie, with occasional growths of fine timber, equally indicative of fertility. A road from the mouth of Fond du Lac River to Galena would be of great advantage to the mines, and a direct route for one might be followed at a trifling expense. It would facilitate the transportation of property from New York by the canal and the lakes."

NORTHWICH, a town of the county of Chester, in the hundred of the same name, being a part of the parish of Badworth, twelves miles from Chester and 174 from London. It is an old-fashioned and insignificant place, standing on the river Wever, which is navigable to Liverpool, and therefore of great importance to the produce in the vicinity of that town. There is an old well-endowed grammar school, and a weekly market held on Friday. The population, partly employed in the cotton manufacture, but chiefly in the preparation of salt, amounted in 1801 to 1338, in 1811 to 1382, in 1821 to 1490, and in 1831 to 1481. Near the town, on the south side, are those pits wherein are found the vast masses of salt which have supplied that condiment to the extent of several hundred thousand bushels for a very long period of time. The principal pit in the Northwich salt-mines is now called the Marston Pit, though it was formerly known under the name of the Burns's Pit. It consists of two levels, the lower of which is one hundred and twelve yards below the surface of the ground, and the other just half way down the shaft. The lower level is the most extensive excavation, as well as the oldest of the two, and has been worked about sixty years. The descent is into a magnificent chamber, apparently of unlimited extent, the flat roof of which presents so great an area, that astonishment is felt by the spectator at its not having long since given way. There is, however, no real want of security, it being as sound and durable as if formed of adamant, and is supported by pillars, in size like clumps of bricks in a brick-field; the extent of the area appears to the eye as if a space equal to Grosvenor Square were under cover. The beauty of the glistening particles of crystallized salt upon the walls, which are as hard as freestone, and the extreme regularity of the concentric curved lines, traced by the workman's tools, are very remarkable. Here and there the solid rock has been blasted, and marks of the jumper chisel are visible. Under foot the whole surface is a mass of rock-salt covered with a layer of the material crushed and crumbled to a state exactly resembling the powdered ice on a pond that has been cut by skaters.

Experiments have been made by boring to a depth of seventeen yards, but they have neither perforated the rock salt, nor do they at present know the thickness of the stratum. The height of this excavation is about fifteen feet, within which space the salt is estimated as being of the best quality; but above, it is somewhat inferior. Thirty-five thousand tons of salt were annually dug out of the different levels, and the area of the whole together amounts to forty-eight statute acres. At one part there is a vista of two hundred yards in length, which has been dignified by the name of Regent Street. The salt, after being prepared by the solution of the rock and evaporation, is formed by wooden moulds, with holes at the bottom, to allow the remaining water to pass through into cubical blocks, and in this state it is shipped, either by the river Weaver and the canal to Weston Point, and thence into the Mersey, or by the canal southward. A considerable quantity of this salt is exported to Prussia. Much salt is prepared from the brine springs, some of which are so strongly saturated as to hold in solution the greatest quantity of salt. To the water of some of these springs rock-salt is added whilst boiling in the pans. From these springs the water, or brine, is raised by a sunk shaft, and a pump worked by an ordinary machine.

Norton || Norway.

NORTON, in Cheshire, a good modern alms-house, erected on the site of a priory of canons regular of St Augustin, founded in the year 1135, by William, son of Nigellus. But the latter did not live to complete his design; for Eustace de Burgaville granted to Hugh de Catharine pasture for a hundred sheep, on condition that he finished the church in all respects conformably to the intentions of the founders.

NORTON'S SOUND, on the north-west coast of America, was discovered in Captain Cook's last voyage, and was so named in honour of Sir Fletcher Norton, afterwards Lord Grantley, a near relation of Mr, afterwards Dr King. It extends as far as north latitude 64. 55. There is no good station for ships, nor even a tolerable harbour, in all the sound. Mr King, on his landing here, discerned many spacious valleys, with rivers flowing through them, well wooded, and bounded with hills of a moderate height. One of the rivers towards the north-west seemed to be considerable; and he was inclined to suppose, from its direction, that it discharged itself into the sea from the head of the bay. Some of his people, penetrating beyond this into the country, found the trees to be of a larger size the farther they proceeded. Long. 197. 13. E. Lat. 64. 31. N.

NORWAY.

Norway is an extensive country in the north of Europe, and, along with Sweden, forming one kingdom. All the countries which now comprise Norway, Sweden, and Denmark, were designated *Scandia* by the ancients. Pliny calls it *Scania insula*, an appellation which derives its origin from the circumstance of the Romans, in the time of their great naturalist, being only acquainted with that part of the country called Skanen or Skonen, the little information which they possessed being obtained from some Germans. This is the ancient province of Schonen or Scania, the most southerly of Sweden. The name was afterwards changed to Scandinavia, which has been called the "storehouse of nations;" but without any just title to such a distinction. It seems now pretty certain that Scandinavia was not the native country of the Scythians or Goths, but that they migrated from Asia to Europe. The fact of Pliny having designated Scandinavia as an island of considerable although uncertain magnitude, has also given rise to some discussion. To the imperfect knowledge of geography which the ancients possessed, may reasonably be attributed their mistaken notion as to the insular position of these countries; but the difficulty may be got rid of in another manner. It is well known that the Baltic Sea has diminished in height to a considerable extent, or, in the language of geologists, the coast on its shores has been elevated. In the course of about a century, this elevation is proved to have been considerable by the high-water marks left upon the rocks on the sea coast at different periods. If the sinking of the water or the rising of the land in this quarter has continued at the same rate from a very early period, then, at the time when Pliny wrote, Scandinavia, penetrated in every direction by gigantic arms of the sea, may have had the appearance of a number of islands of different forms and dimensions.[1]

But our present purpose is with Norway, which in Swedish is called Norrige, and in Danish, Norge, pronounced Norre. "In spite of the vague ideas which the ancients entertained of the northern countries of Europe," says Malte-Brun, "it cannot be doubted that the country which Pliny[2] calls Nerigou is Norway. Many geographers[3] have asserted that the name signifies the 'Way of the North;'[4] but its true etymology seems to be *Nor-Rige*, Kingdom of the North, or rather, perhaps, assuming the word Nor as signifying *gulf*, Kingdom of Gulfs, because in effect its coasts are much more indented than those of Sweden. We thus see that the name of Nerigou has much more analogy with that of Norrige than with that of Norweg, which at the first glance appears to be the origin of the modern name."[5] The early history of Norway is interwoven with the annals of Sweden and Denmark, and consists in legends contained in the Heimskringla or Saga, a collection of ancient manuscripts, which is to Norway what the Edda is to Iceland. The petty sovereigns who held sway in Norway in remote ages were independent, but appear to have acknowledged a kind of supremacy in the kings of Sweden and Denmark, probably more nominal than real; but until the ninth or tenth century little is known of the annals of the country. The Norwegians, of course, constituted no inconsiderable proportion of those daring adventurers who, under the general name of Normans on the continent, and Danes in Britain, became at one time the terror of all the maritime parts of Europe.[6]

History.

The Royal Northern Antiquarian Society of Copenhagen has published a series of the Saga, comprehending the historical account of events which belong to European history, and also to that of Scandinavia, during the eleventh and twelfth centuries. It includes a period of about one hundred and seventy years, beginning with the Saga of St Olaf, the contemporary of Canute the Great of England, who assumed the crown of Norway in 1013, and continuing the series until the death of Magnus Erlingson in a sea-fight with Sverrer I. in 1184. This is one of the most

[1] Such is the opinion hazarded by Gibbon on a subject which admits of much curious speculation. The extraordinary elevation of the land in these northern regions has been fully confirmed by recent investigations.
[2] Lib. iv. cap. 16.
[3] See the article Norwege, in the *Dictionaire Géographique de l'Encyclopédie*.
[4] From *Nord*, and *theg* (way) Norweg.
[5] Malte-Brun's Geography, vol. viii. p. 517.
[6] See the articles Denmark, France, and England.

Norway.

curious and minute pictures of an age long past, which the literature of Europe is possessed of. It is not only valuable as an historical document, confirming or adding to our stock of facts relative to a dark period of English history, but as a record of the social condition of the country at that time, and of the influence of the Thing, or assembly of the people; a reference of all matters to this popular convocation being one of the most striking facts recorded in the Saga. From these rude annals we learn, that at a period immediately preceding the first traces of free institutions in our own country, similar institutions existed in great activity amongst these northern people. It seems a fair inference from these facts, therefore, that we owe the political institutions which we enjoy to the Danes and Normans, who were more likely to impose their own peculiar institutions upon those whom they subdued, than to receive institutions from the conquered.

From other Sagas preceding that of St Olaf, we learn, that about the middle of the ninth century, Halfden the Black divided Norway into five districts, with fixed head places for holding Things in each. At these assemblies, laws were framed suitable to the local circumstances of each district, which gave its name to the code. This potentate was succeeded by the celebrated Harold Harfagr, or the Fair-Haired, who ascended the throne at ten years of age, and reigned from 863 to 936. This warlike monarch, after long fighting, reduced all the independent nobles or petty kings to the condition of subjects, and consolidated the various principalities of Norway into one kingdom. Thus was consummated in a single reign, and that too in the ninth century, a work which afterwards cost the other nations of Europe several centuries of bloodshed and contention. But this was more easily accomplished in Norway than elsewhere; for in that country the great nobility never had feudal powers, and consequently those who were under them as servants were bound by no such ties of vassalage as the retainers of a Highland chieftain or a Norman baron. They were not taught passive and unconditional submission to a superior, although he might bear the title of king; for before a small sovereign could make war, he was under the necessity of assembling the Thing, and obtaining its sanction. The equal division of property amongst children, which extended to the crown itself, prevented the accumulation of power in the hands of individuals; and the circumstance of the total want of fortresses, castles, or strongholds in the country, owing to the division of estates, effectually prevented a nobility from attaining the same power with the nobles of feudal countries, and setting the royal authority at defiance. Some of these nobility or small kings colonized Iceland; and Normandy was conquered by Rolf Gangr, one of those whom Harold Harfagr expelled from Norway. In this king's reign Christianity was introduced into the country, and from this period the events recorded in the historical Saga may claim some degree of confidence.[1] The length of this reign was no doubt favourable to the lower orders, by consolidating their institutions, which, as they weakened the authority of the petty kings, were favoured by Harold. Eric, his son and successor, whom he had associated with himself in the royal authority, was deposed by the Thing on account of his cruelty, and a younger brother succeeded him. Hakon, which was the name of this son of Harfagr, was brought up from his childhood at the court of Athelstane, king of England. He reigned nineteen years, during which period there was frequent reference to the Things, both for amending the laws, and for the dissemination of Christianity. It appears, that in attempting to establish the religion of the Cross in his dominions, Hakon had recourse to what were considered as unconstitutional means; for we find that at a meeting of the Thing, held in the year 956, a husbandman named Asbiorn, of Medalhuus, stood up and declared, on the part of his neighbours and of himself, "that they had elected Hakon to be their king, upon the condition that freedom of religion and freedom of conscience should be warranted to every man; and if the king persisted in attempting to suppress their ancient faith, they would elect another king;" adding, "and now, king, make thy choice." This is certainly one of the most striking instances of parliamentary patriotism to be met with in the history of Europe; and we must descend six or seven centuries nearer to the present time before we can match it in the annals of our own country. Hakon was not only compelled to give way, but also to take part in the heathen ceremonies of the meeting. This king was slain in 963, in a battle with the sons of his elder brother Eric, upon whom Athelstane of England had conferred the kingdom of Northumberland.

It appears that, after the death of Harfagr, the small kings again had risen to some degree of power, and that each in his own assembly, called also a Thing, had exercised a limited authority. Olaf the saint, before he assumed the name of king, consulted one of these assemblies of the nobility as to the way of proposing his claim as heir of Harfagr to the general Things of the people; and proceeded in such a manner as to show that their voice alone was insufficient to constitute him supreme chief in the land, without the sanction of the general Thing. These institutions appear to have always conferred or confirmed the royal prerogative, and to have been of great importance in that age amongst the whole Scandinavian people. In cases where the good of the community was at stake, they set the royal authority at defiance, and obliged the sovereign to accept of such international contracts as the Things of both countries conceived was for their mutual benefit. The Thing of Sweden compelled the sovereign of that country to conclude a peace with Norway, and to bestow his daughter in marriage on King Olaf, towards whom he cherished implacable enmity. Olaf had the title of saint conferred on him from the exertions which he made to introduce Christianity amongst his subjects; but in prosecution of this object he exercised the most atrocious cruelties, and completely alienated the affections of his people. He attempted to govern without the intervention of the Things, which became the cause of his ruin; for when Canute the Great, who conquered Norway, invaded his dominions, the people literally "stopped the supplies;" and, unable to collect a force sufficient to oppose the king of England, he was compelled to seek refuge in Russia. For the purpose of recovering his crown, he landed in Sweden with a few followers, and, having received an accession to his force from the king of that country, who was his brother-in-law, marched from the Gulf of Finland across the peninsula to the Fiord or Gulf of Drontheim. In the mean time the Thing of Norway raised an army of twelve thousand bonder, and placed it under the command of Olver of Egge. At the debouche of the valley of Værdal they met Olaf at the head of about four thousand adventurers. The conflict could not be doubtful where there was such an inequality of numbers, and where the superiority lay on the side of those who were fighting in defence of their li-

[1] Harold Harfagr was born in the year 853; he began to reign in 863, and died in 936. St Olaf's father was Harold Grændske, his grandfather Gudrod, his great-grandfather Biorn Stærke, and his great-great-grandfather Harold Harfagr, and St Olaf was born anno 995, only fifty-nine years after the death of his great progenitor Harfagr. A contemporary of St Olaf was therefore a credible source of information for all the events of Harfagr's reign, such as the conquest of Normandy by Rolf Gangr, the colonization of Iceland, &c. (Laing's Journal of a Residence in Norway.)

berties. King Olaf was defeated and slain, without even showing the prudence and courage which had distinguished his early career. This battle was fought on the 31st of August 1030, and not on the 29th of June or July 1033, as is commonly stated.[1] The body of the fallen monarch was transported to Saint Clement's Church, in Drontheim, which had been erected by himself. In return for the services which he had rendered the church, the clergy soon afterwards canonized him; and even at Constantinople temples were erected to his memory. His tomb was regarded as a consecrated spot, to which pilgrimages were performed, not only by ardent devotees from the north, but also from the south of Europe.

Canute the Great did not long remain in Norway; and from the period of Olaf's death the country was ruled by native monarchs, who even for a time governed Denmark. It may be gathered from the ancient chronicles before referred to, that at this period society was composed of four distinct orders. The first was the nobility, who were descendants of royal families; and, without regard to priority of birth, those who were descended both on the mother's side and father's side from Harfagr were eligible to the supreme monarchy. They appear to have had no civil power or privilege as nobles, but merely this odelsbaarn-ret to the crown. The odelsbaarnmen, bondermen, or husbandmen, were the proprietors of lands held neither from the king nor from any feudal superior. These were the people who had a voice at the Things. A third order consisted of the unfree men, holding land for services as vassals or as labourers in cottages, but who had no voice in the Things in respect of their land. A fourth order was composed of the trælle or domestic slaves, who were private property, and in a lower state than the former class. This condition of society, which was equivalent to slavery, was abolished by Magnus VII., who reigned from 1319 to 1344.

The most important event in the history of Norway, Sweden, and Denmark, in the middle ages, was the union of the three kingdoms under one sovereign, Margaret, daughter of Waldemar, king of Denmark, which was effected by the league of Calmar, in the year 1397. The circumstances which led to this remarkable occurrence will be found narrated in the article DENMARK. Had this princess been as capable of conquering national prejudices as she was of defeating armies, her dominions would have constituted a great and powerful monarchy. But the passions of her people were more than a match for her policy; and it was no doubt better that the three nations which she governed should each remain in quiet possession of its own freedom, as enjoyed under its own form of government and laws, than that they should lay aside all differences, and, heartily uniting as one kingdom and people, become the terror and scourge of Southern Europe. Margaret died without issue; but during her lifetime she appointed her grand-nephew, whom some historians call her cousin, Eric, a descendant of the Dukes of Pomerania, as her successor; and he acceded to the triple crown of Scandinavia in 1412. The union, however, was far from being cordial, and for rather more than a century local insurrections from time to time broke out and distracted the country. The Swedes, in particular, felt great reluctance to submit to a foreign dynasty; and after various attempts on their part to shake themselves free from the compact of Calmar, the oppression and cruelty of Christian II. led to the final separation of Sweden in 1520, under the celebrated Gustavus Erickson or Vasa. Norway and Denmark, however, remained under one sceptre till, at the adjustment of European affairs after the fall of Napoleon, Norway was separated from Denmark, and united to the crown of Sweden. This took place in the year 1814.

The circumstances which led to the forcible separation of two countries that had for centuries been united by the closest relations, and the union of one of them with another country which had for as many ages been regarded as a natural enemy, may be shortly stated. The grand object of the leading powers was to induce every state to join in the league against Napoleon; and Sweden, in consideration of an ample bribe, acceded to the general confederacy. One of the foulest stains on the escutcheon of Great Britain is the treaty which she entered into with Sweden, dated 3d March 1813. By this notorious compact against the liberties of a whole people, England gave to the king of Sweden the kingdom of Norway (which was no more hers than Rome or Pekin), together with Guadaloupe, and a million of pounds sterling, as a remuneration to his Swedish majesty for joining the allied powers against France.[2] After the battle of Leipsic, fought in October 1813, the Crown Prince of Sweden entered Denmark with his army, and, after some bloody scenes in Holstein, peace was concluded at Kiel on the 14th of January 1814. By this treaty Denmark gave up all right to Norway, considering it as quite hopeless to enter into a contest with Sweden and England. Although the king of Denmark might relinquish his claim to the sovereignty of Norway, this was no reason for the people of that country making an unconditional surrender of themselves to a foreign potentate. They declared themselves an independent nation, framed a constitution of their own, and proclaimed Prince Christian, son of their former sovereign, and governor of Norway, as their lawful king. Not a little blood was shed in the contention between Sweden and Norway; and England actively interfered, by blockading the ports of Norway, for the purpose of starving the inhabitants of the country into subjection. But a speedy settlement of the question became necessary to all parties. The constitution which the Norwegians had prepared in April 1814, and which they were in arms to maintain, was guaranteed to them, upon condition of their accepting along with it the Swedish monarch as king, and the Crown Prince of Denmark abdicating the throne. Matters were arranged on this footing; and on the 17th of May 1814, both parties, the king of Sweden and the Norwegian nation, solemnly entered into a compact to the effect stated, under the sanction and guarantee of the allied powers, and of Great Britain amongst the rest.[3] By the treaty, the entire independence of Norway as a kingdom was secured, the crowns alone being united, as in the case of Hanover and England. She had a constitution of her own framing, a legislature of her own electing, without being interfered with by any foreign authority in the exercise of her right, and laws of her own making and administering; in short, Norway remained a pure democracy in all but the name.

Since this union of Norway and Sweden under one so-

[1] This is put beyond a doubt by a circumstance which all accounts of the battle mention, namely, that a total eclipse of the sun occurred on the same day. Professor Hansteen of Christiania has calculated that such a celestial phenomenon could only have taken place on the 31st of August 1030.

[2] In the article containing the accession of England to the treaty, after various mutual stipulations, there is a provision containing the following words: "And his majesty the king of Sweden engages that this union shall take place with every possible regard and consideration for the happiness *and liberty* of the people of Norway."

[3] It is a fact worthy of being recorded, that the committee which drew up this constitution, and laid it before the national assembly, sat only four days, viz. from the 12th to the 16th of April. That so perfect a model of a free constitution should have been framed in so short a period, is truly marvellous; especially as it was not a rough, unfinished outline, but a system of government complete in all its details.

Norway.

vereign, there have occurred only two events of any importance in the history of the former. The first was the abolition of hereditary nobility by the Storthing; and the second was an attempt of the Swedish cabinet in 1824 to force on the Norwegian people an entire amalgamation of their country with Sweden. But the firmness of the Storthing or parliament, the honourable feelings of the sovereign, and, it is said, the interference of Russia on the part of the allied powers, prevented such an infamous attempt to violate the faith of treaties, and bring disgrace upon those who had guaranteed them. Great Britain, as a party to the treaty of 1813, and as having inflicted some injury on the country by her ships of war, was especially bound to protect the liberties and national independence of Norway, and to preserve her from becoming a mere province of Sweden, as Poland is now of Russia.

The facts relative to the abolition of hereditary nobility may be shortly stated. It is fixed that the executive power has not a final veto, but only a suspensive negative, till the law is passed by three successive Storthings. In the year 1815, both chambers of the Storthing proposed and passed a motion to abolish nobility for ever in Norway. The slender remains of this class were of foreign, and almost in every instance of recent origin; besides, few of them had enough of property to enable them to hold a dignified station in society. By the law of succession land is equally divided amongst all the children, so that large estates could not be entailed on the possessor of the family title; and hence, to maintain his rank and respectability, a nobleman must have become a placeman or a pensioner, or engaged in operations which would bring nobility into contempt. The existence of an hereditary nobility, in a country where the law of primogeniture was unknown in the succession to real property, seemed, therefore, an anomaly, which, in any circumstances, could not long be tolerated, and which was altogether unsuitable to the state of things which had long obtained in Norway. The royal assent, however, was refused to the proposed enactment in 1815, and again in the year 1818, after it had passed through a second Storthing. To prevent it from passing a third time became the grand object of government; for then it would necessarily have become the law of the land, with or without the royal consent. In 1821, the year when the measure was to be again brought forward, the king in person repaired to Christiania, and used every means to induce the Storthing to abandon it; but in vain. Six thousand soldiers were marched to the neighbourhood of that city, to overawe both the legislature and the people, and extreme irritation prevailed. At this critical moment, when the flames of civil war were about to be kindled, both the Russian and American ministers interfered. What arguments or remonstrances they employed is unknown; but the fact is, that government lowered its tone, the troops were withdrawn, and the Swedish cabinet gave way. The Storthing having passed the measure abolishing hereditary nobility for the third time, it consequently became law. Norway, therefore, remains a pure democracy, federally united with the monarchy of Sweden. Its constitution has outlived two dangerous attacks upon it; and as the principles upon which it is based have been developed by practice, it has gained additional strength, and been further secured by the love and veneration of the people. The sudden disjunction of Denmark and Norway, left, of course, much business to be adjusted between individuals of the two countries. It thus occasioned much distress and loss to persons having connections and property in both; and it still produces a constant intercourse. Few, we believe, will admire the manner in which the union between Sweden and Norway was effected; but as few will doubt the benefits which must result to both from the exchange of mutual hostility for mutual cordiality, and to a certain extent an identity of interests.

Physical aspect.

If the reader turn to the map of Europe, he will find that Norway extends from the fifty-eighth to the seventy-first degree of north latitude, and at the broadest from the fifth to about the thirteenth degree of longitude east from Greenwich. On the east it is bounded by Sweden, on the west and south by the North Sea, and on the north by the Arctic Ocean. At the broadest part it is scarcely three hundred miles across, and north of the sixty-third degree of latitude the breadth is very inconsiderable, the country narrowing to a mere belt. Its shape is very peculiar, and, in the main, it strikingly resembles that of a Florence flask, the rounded bottom being presented to the south, and the long narrow neck stretching to the north. Norway thus begins about the point where Scotland ends, that is, the Naze. The most southerly headland in the former is nearly in the same parallel as the Pentland Frith, which divides the latter country from the Orkney Islands. These facts will serve to convey a somewhat precise idea of the position of Norway. The sea-coast presents features similar to those which characterise Iceland, the North of Scotland, Newfoundland, Nova Scotia, Labrador, and other islands and continental tracts of country exposed to the storms, the currents, and the perpetual buffetings of the Northern Ocean. The action of the sea alone, however, could not have formed such immense fissures as are found in the solid primary rock on the Norwegian coast. The theory of the elevation of the land by volcanic impulse from below seems alone sufficient to account for such phenomena.[1]

The greater part of Norway may be said to have an outer and an inner coast, the former being a succession of rocky islands of all dimensions, from a mere point to more than a mile in length, and lying within about a mile of the mainland, thus circling all the coast as with a girdle. Boats and small vessels make their coasting voyages within the rocks; for, even when the ocean is strongly agitated, the outer barrier acts as a sort of break-water, preventing the channel within from being thrown into violent commotion.

Those immense arms of the sea which penetrate deep into the country are called fiords in Norway; a name in geographical nomenclature identifying them with the friths of Scotland, to which they bear a general resemblance, and also to the maritime lochs so numerous on the west coast of that country. To enumerate these were only to present a catalogue of names designating the same object in different situations and of different sizes. They vary from sixty to two hundred miles in length, and from being several miles to less than a gunshot in breadth; and altogether they constitute one of the most remarkable physical features of the country. The inland streams generally empty themselves into these fiords; and, as in the case of the Friths of Forth, Clyde, and others, in Scotland, it is often difficult to say where the river ends and the ocean begins. All along the rock-bound coast these arms of the sea succeed each other with melancholy sameness; but in penetrating within their sombre and sometimes dangerous mouths, the scene is all at once changed, presenting, at the bottom of these bays, creeks, and other indentations, towns of a pleasant and cheerful aspect, and banks finely wooded with all the va-

[1] Indeed, the large rounded boulder stones found on the tops of the highest mountains afford evidence sufficient of the fact that at one time Norway had been submerged beneath the Northern Ocean. That the sea never flowed in this quarter of the globe (and consequently in every other), eight thousand feet (the height of the highest mountains) above its present level, may readily be taken for granted. We may, therefore, conclude, that the land has been raised by some mighty power; and we know of none which could effect this but the pent-up fire and compressed gases of a volcano, which, striving for vent, upheaved the solid pavement of the globe which lay above them, and thus broke it up into innumerable fragments.

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rieties of those forest trees which we are accustomed to meet in more temperate latitudes, and studded with cottages, farm-houses, and country residences, indicating taste and comfort, if not luxury and wealth. The tide rushes into many of these fiords with great violence, especially on the north-westerly quarter of the peninsula. This is readily accounted for from the fact, that the interior basins are often very capacious, whilst the mouths by which the water flows in to fill them are frequently very confined. Opposite to Folden Fiord is the Maelström, or Moskoestrom, long celebrated as the most appalling whirlpool in Europe; but it owes much of its reputation to the exaggerated accounts of travellers. It is situated nearly at the extremity of the range of the Lofoden Islands, beginning between Moskoenæs and Moskoe, and exhausting itself between Varoe and Rost, the last of which is the most westerly of the Lofodens. The whirlpool is simply caused by the rushing of the ocean, as the tide rises and falls, between this chain of islands, which impedes its course like the narrow mouths of the fiords. The relative position of the surrounding islands causes the Maelström to form a large circle; and the great inequalities of its bottom, which, from a few fathoms, deepens suddenly in many parts to 200, increase the violence of the current.

The interior of Norway is traversed by a succession of mountain ranges, called Fjeldes, whence the Cumberland term Fell, designating an elevated tract of ground. Some geographers have divided the Scandinavian Alps into groups, a classification which appears to be more fanciful than real. Those which intersect Norway, extending from the southern extremity of the country to Cape North, the most northerly point in Europe, are called the Dofrines; and the most considerable of these ranges is the Dovre Fjelde, lying between the sixty-second and sixty-third parallels of north latitude. Travellers are proverbially prone to give exaggerated descriptions of the physical features of the countries which they traverse; and from this cause our ideas of the height of the Norwegian mountains, and the sublimity of the scenery which they present, have hitherto been pitched rather above the truth. Mr Laing, in his excellent account of the country, thus describes this great natural feature of Norway. "The Dovre Fjelde here (at Jerkin, on the northern verge of the range) may be from twenty-four to twenty-eight miles across. When we give things their real names, we take away much of their imagined grandeur. The Dovre Fjelde sounds well, and we fancy it a vast and sublime natural feature. It really is no more than a *fell*, like those of Yorkshire or Cumberland; an elevated tract of ground, whence run waters in opposite directions, and which forms the base of a number of detached hills of moderate elevation. In fact, as a scene impressing the traveller with ideas of vast and lonely grandeur, the tract from the waters of the Tay to those of the Spey, by Dalnacardoch, Dalwhinny, and Pitmain, greatly surpasses it. You are indeed 3000 feet above the level of the sea; but that is not seen; it is a matter of reflection and information. You look down upon nothing below you, and look up only to hills of moderate elevation. Schneehœtte alone comes up to a mountain in magnitude: it is 7300 feet above the level of the sea; but this fell is 3000 at this farm-house (Jerkin, where Mr Laing resided), which is about twelve miles from the base of Schneehœtte. The actual height of this mountain, therefore, for the eye, is about the same as that of Ben Nevis, about 4300 feet, with the disadvantage of gaining its apparent height by a slow rise from the fell. There is a considerable mass of snow in a hollow on the bosom of Schneehœtte, but not more than remains for great part of the summer on hills in Aberdeenshire, and nothing like a glacier.[1] The head and shoulder are clear of snow. The most remarkable feature of this mountain tract is, that the surface of the fell, and of Schneehœtte to its summit, is covered with, or more properly composed of, rounded masses of gneiss and granite, from the size of a man's head to that of the hull of a ship. These loose rolled masses are covered with soil in some places, but in others they are bare, just as they were left by the torrent which must have rounded them, and deposited them in this region."[2] Mr Laing was informed by one of the officers employed in the trigonometrical survey of Norway, that Schneehœtte is not the most elevated of the Norwegian mountains, and that, in all probability, Hurunger Fjelde exceeds it by about 700 feet. The names of the other elevations to the south and west of Dovre Fjelde, are Lang Fjelde, Stagen Fjelde, Sogne Fjelde, Skagen Fjelde, Fille Fjelde, Hardanger Fjelde, and some others which need not be named. The Hurunger, the Fille, and the Hardanger Mountains, running into the sea at the Naze of Norway, "form, with the Dovre Mountains, one vast triangular range, with its apex at Lessoe, and its base overflowed by the ocean in the height called the Shagerrak."[3]

Lakes, rivers, and cataracts.

There are a number of lakes in Norway, the largest of which is the Myosen, a splendid sheet of water, about eighty miles in length and from one to ten in breadth. Its scenery has been classed with the pastoral or beautiful, rather than with the sublime. Its shores are well cultivated, and, with the exception of a few rough promontories dipping into the lake, the slopes are easy, and yield fine crops of oats, bear, flax, pease, and potatoes. Its direction, like that of a great many of the lakes and rivers in Norway, is from north-west to south-east, crossing the sixty-first parallel of north latitude. The depth of the Myosen varies greatly; but it is considered as shallower than most of the other Norwegian lakes. The depth in the lower parts is not more than forty fathoms, often it is much less; but in the upper part it has been found to exceed a hundred. Yet even this is nothing in comparison with the depth of the other lakes, particularly of the Famund Soe, which is reputed to be unfathomable; a distinction always allotted to the deepest lake in every mountainous country. A large stream, called the Vormen Elv, issues from the southern limit of Lake Myosen; and at Sunde, which is its northern extremity, it forms a communication with Lake Losness, or Losness Soe, by the Lossen Elv or River, which derives its name from the lake. Into this lake flows a river which rises in the Dovre Fjelde range of mountains, and appears to be the one alluded to by Mr Laing in the following passage. "The stream which runs through Gulbrandsdal and the Myosen, and reaches the sea at Frederickstad, being the same I left at Lien, comes down from the hills at or near Lessoe, and is there divided into two branches, one of which, as above stated, runs into the Myosen, and the other into the North Sea at the fiord in

[1] Glaciers, however, are not unknown in Norway. Mr Lloyd, in his Field Sports of the North of Europe, observes, confirming what Mr Laing says in reference to Schneehœtte, "There were no glaciers on Schneehœtte, though such are to be found on several others of the Norwegian mountains. Justedalsbraen, or Sneebraen, as well as Folgefonden, Mr Forsell says, are the greatest glaciers in Europe." This we are inclined to consider as a great exaggeration. We learn from another authority, Mr Edward Forbes, that one of the glaciers, forming a branch of the great Folgefond, is yearly diminishing in size; a remarkable circumstance, but by no means an anomaly.

[2] Laing's Residence in Norway, p. 52–3.

[3] Generally speaking, all the mountains of the Fjelde tract slope gently towards the Baltic and the north-east, whilst towards the north-west they are steep and abrupt, and in some instances almost perpendicular from the top to the bottom.

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Romsdal amt, in which the town of Molde is situated, thus including in its delta between four and five degrees of latitude, and all the west and south of Norway. The course of this little river from Lessoe to the sea is very important, as it gives precision to our ideas of the shape and direction of the Dovre Fjelde, and its connection with the Hurunger, the Fille, and the Hardanger Mountains." This river must therefore have a course of probably one hundred miles in a north-westerly, and above two hundred and fifty in a south-easterly direction. It is in several parts of its course of considerable breadth, and at more than one hundred miles from its embouchure is described as a large dark-coloured and rapid river. A still larger stream is the Glommen, called by way of distinction Stor Elven, or the Great River, from its being the largest in Norway. It rises in the government of Drontheim, not far from Ovesund Lake, through which it runs; and it afterwards traverses the extensive government of Christiania, flowing through Osterdaelen and Hedemarken, passing Kongsvinger, and finally falling into the sea at Frederickstad, after a course of not less than three hundred miles, all in Norway. From the heart of this continent it opens an easy communication with the ocean, and through its means the produce of the interior is brought down to the coast. At about two hundred miles from the sea it is described as a fine majestic stream, two hundred yards in breadth. Navigation, however, is obstructed by numerous falls, one of which, not far from its mouth, is called the cataract of Sarpen, the roar of which is heard at a great distance. There are other falls on the same river; but the most stupendous natural phenomenon of this description is situated upon the opposite side of the mountain range, on streams which flow into the North Sea. Mr Lloyd[1] describes the falls of Rinkanfos and Voringfos as particularly grand, the first having a perpendicular descent of 450 feet, and the second of 900 feet, the body of water in both cases being very considerable. Mr Forsell, in giving some statistical information regarding Norway, mentions other falls even more stupendous than these. There are many other lakes and rivers in Norway besides those which we have described, amongst which we may mention the Torris Elv, called the Odderen Elv during part of its upper course, a large stream, which enters the sea at Christiansand; the Topdals, which falls into the sea near the same place; the Louven Elv, which rises in the Hardanger Fjelde, traverses several long, narrow lakes, passes through Kongsberg, and enters the sea near Nauvig, in latitude 59°; and between this stream and the Lossen, which lies considerably to the north-east, there is more than one large river. A multitude of streams also run into the North Sea. The most important of these is the Namsen, which, from its exit out of the lakes that give rise to it, has a course of about ninety miles. From the ground sloping with more rapidity upon this side of the mountain chain than on the other, the water-courses must be considerably steeper. "Few countries in the world," says the traveller just mentioned, "present such sublime natural scenery; its numerous lakes and rivers, its magnificent cataracts, its boundless forests and solitary wilds, where silence seems to brood eternally, its terrific precipices, its smiling valleys, and its towering alps covered with everlasting snows, impress the mind of the traveller always with admiration, and often with awe."[2] The forests of Norway, as is well known, are large and numerous; but they do not appear to be so extensive as those of Sweden. In the southern parts of Norway, indeed, and up as far as Drontheim, the supplies of timber are very considerable; but to the north of the latter place, and along the sea-coast, as well as on the mountain ranges, wood is not plentiful, many parts of the country being perfectly destitute of it. Norway, however, from the district of Drontheim southwards, may be considered as a country abundantly supplied with gigantic forests of magnificent trees, amongst which the pine, birch, and aspen, are the most celebrated and the most valuable to the inhabitants.

Geology.

The prevailing rocks found in Norway belong to the primitive and transition series. The west coast is wholly composed of primitive rocks, gneiss and mica slate greatly predominating. Secondary rocks occur but rarely, and alluvial deposits are not so abundant as in many other less extensive regions. Contrary to the general belief of geologists, granite is but a rare rock. When it appears, it is frequently in veins traversing the primitive stratified rocks, or running parallel with beds or strata; and sometimes it is found spread over the surface of mica slate, as at Forvig; or irregularly associated with clay slate and diallage rock, as in the island of Mageroe. But by far the most abundant rock in Norway is gneiss, all the others of the primitive series appearing to be subordinate to it. Extensive tracts of country, and long mountain ranges, seem to consist almost entirely of gneiss. In some parts it abounds in veins of rose and milk quartz, in iron ores, in garnets, sometimes the precious, but most frequently the common garnet, and other minerals. Mica slate, however, which rests upon and alternates with the gneiss, is far from being so generally distributed, as is also the case with the clay slate. In some places steatite occurs in beds, and is quarried in slabs to be used for different purposes. Quartz rock, various hornblende rocks, and limestone, occur in beds subordinate to the gneiss and mica slate. One side of the valley of Shalheim, situated between Bergen and Sognefiord, is bounded by hills of snow-white quartz, which are almost bare, and present mural precipices, having a very singular appearance at a distance, from their shining-white colour. Gabbro or diallage rock occurs in great quantities, connected with clay slate, in the island of Mageroe, and in other parts of Norway. The class of transition rocks contains, besides graywacke, alum, slate, limestone (combined with some tremolite), and other rocks well known to mineralogists as belonging to the following series:—1. Granite, which sometimes contains hornblende; 2. syenite, which contains a beautiful Labrador variety of common felspar, and numerous crystals of the gem named zircon; 3. porphyry, and associated with it various trap-rocks allied to basalt and amygdaloid.[3] All the mountains, and especially those of the south, contain a great number of minerals sought after in collections, and of metals valuable to man, amongst which may be mentioned gold, silver, iron, copper, cobalt, and others. The mines of silver in Norway are situated at Kongsberg, but although they once afforded rich returns, they now scarcely repay the labour bestowed on them. Large masses of native silver have been found here, one of them, now in the Museum of Copenhagen, weighing upwards of five hundred pounds. The Kongsberg mines abound with mineralogical curiosities, of which the most remarkable is native electrum, a natural alloy of gold and silver.[4] There is a gold mine at Edswold, in the district of Rommarge, and mines of lead and silver in that of Jarlsberg; but they have not been wrought to any extent. The copper mines of Norway are chiefly situated in the northern division of the kingdom. The most considerable are those of Raeraas, which were discovered in 1644, at the base of the Dovre Fjelde Mountains. The

[1] Field Sports of the North of Europe, vol. ii. p. 295.
[2] Ibid. p. 293.
[3] Professor Jameson in Murray's Geography, p. 768; and a communication from Mr Forbes.
[4] Elliot's Letters from the North of Europe, p. 103.

Norway. other copper mines are from fifteen to twenty leagues from Drontheim, at Quiknc, Laekken, Selboe, and in the district of Christiania at Fredericksgave or Foledel. The principal iron mines are situated in Southern Norway; and of these the most distinguished are those of Arundal and Krageroe. The mines of Arundal are celebrated for the richness of their mineralogical treasures. Many of these are rare, such as botryolite, datholite, wernerite, scapolite, and moroxite; besides abundance of epidote, actinolite, cocolite, and colophonite. The ore (magnetic iron orc) is found in beds of gneiss, of which the country is chiefly formed. The mine of Laurwig, in the vicinity of the town of that name, affords annually 26,000 quintals of bar iron, and 6000 quintals of cast iron. The establishment of the same kind at Moss affords annually 10,000 quintals of bar and cast iron. Other mines, situated in various parts of the country, likewise yield large quantities of this valuable metal; and the whole produce of the Norwegian mines has been estimated at about 150,000 quintals annually. The mines of cobalt, which are worked at Modum and Fossum, are extensive, but not very deep. There is a mine of plumbago and black lead at Engledal. The mines of alum, which are worked in the mountain of Egcberg, near to Christiania, afford not only a sufficiency for the consumption of the Danish states, but some for exportation. Norway possesses quarries of granitc, marble, millstone, whetstone, slate, and clay. Granite is exported to Holland, and marble and other minerals to Denmark.

Norway possesses an island called Berend Island, situated between Spitzbergen and North Cape, which presents some interesting features to thc geologist. It is about thirty English miles in circumference, and is composed of a formation totally different from the primary rocks of which the Norwegian peninsula, and, it is understood, Spitzbergen, and other polar islands, consist. The whole island appears to be one entire mass of coal. It is not the fossil-wood brown coal, or surturbrand, found in Iceland, Germany, and somc parts of the west of England, but mineral coal. Quantities of it have been brought to the mainland by vessels sent to hunt the white bear and the walrus, which abound in the icy region where Berend Island is situated.

Ancient lakes, &c. Some valleys in Norway give abundant indications of their having been lakes of fresh water, which were either gradually drained as the land became elevated, or, bursting the barriers that confined them, suddenly laid their basins dry. Mr Laing describes one of these in the following passage. "On ascending the steeps which bound the flat alluvial bottom of the valley on each side, and which consists generally of banks of gravelly soil, one is surprised to find a kind of upper terrace of excellent land, cultivated and inhabited like the bottom, and consisting of the same soil, a friable loam. This terrace rests against the primary rocks of the Fjelde, which are here limestone, marble, and gneiss, or rock of the micaceous family, of which the laminæ are singularly twisted and contorted; and the terrace has evidently been the bottom of an ancient lake which has been bounded by these Fjelde ridges." The same traveller gives an account of one of these ancient sea-beaches, which, in other countries besides Norway, are calculated to arrest the attention and excite the wonder of the observer of nature. He is speaking of the Snaasen Vand, a lake some sixty or seventy miles north from Drontheim. "About seven miles inland from the present sea strand, at the head of the fiord, and about sixty feet above the present high-water level, there is an ancient sea-beach of a very remarkable character. Above the house of Fossum, and forty feet higher than the lake of that name, the sea-shells are so abundant that they might be applied to agricultural purposes, and they lie close to the surface." At another place in the neighbourhood there is a large bed of shells, which have been used in mending the road for a considerable distance towards Snaasen Vand. "They are entire; the upper and under ones of the mussel, cockle, and clam are united, and the mussels grouped together, as in the living state; so that this bed has clearly been the spot upon which the animals lived." From these and other indications, it is concluded, that a shore in a direction nearly parallel to that of the present one of the Drontheim Gulf, and on a level at least sixty feet higher, has existed at a recent geological period. These beds are not covered with any thickness of decayed vegetable soil, and the shells retain in part their natural hue and enamel. The land, therefore, has been elevated at no very distant period; at what rate per century has not been determined as to this side; but the Swedish philosophers assert, that the change of level in the Gulf of Finland is at the rate of four feet and a half in a hundred years. Such could not have been the case on the shores of Norway washed by the North Sea; for the relative position of known points upon the line of the sea-shore, to the present level of the sea, are by historical evidence ascertained to have changed little if any during a thousand years. The change of level may have been local, or it may have gone on more rapidly at one time than at another.

Earthquakes have been repeatedly experienced in Norway, at least seven having occurred within the last forty years. History records one which occurred at Drontheim on the 18th of July 1686, and another on the 1st of April 1692. On the 14th of September 1344, the river Guul disappeared in the earth; and on its bursting out again, destroyed forty-eight farms, and 250 human beings. About the same time a great earthquake took place in Iceland. Indeed the whole aspect of this country bears evidence to the fact, that at some period, or more probably at different periods, its surface has been elevated, depressed, and shattered by great convulsions.

Botany. It would occupy too much space to enumerate in detail the characteristic plants of Norway. The vegetation of the west coast is very similar to that of Britain, but in the south and east there is found a completely different Flora, approximating to that of Denmark and Germany. The cause of the remarkable difference between the Flora, and also the Fauna, of the two coasts, is probably to be referred to the absence of tides on the south coast. This circumstance seems to exercise an important influence on the character of the natural productions of the country; and we the more especially refer to it, as it seems to have been hitherto entirely overlooked by naturalists. At Bergen the tide falls six or eight feet, but on the south coast it does not fall six inches.

Zoology. The animal kingdom of Norway requires some notice. As population has increased, the wild animals have of course gradually disappeared, and the bear and the wolf are no longer the terror of the traveller, as they were wont to be. In winter, indeed, they may sometimes be found in disagreeable proximity to a stranger who intrudes within their range; but they are in general timid, and only formidable in herds. In Norway the bear retires to his den, which is generally some sheltered hole in the rocks of the Fjelde, in November, and remains in a state of inactivity, without food, it is said, until April. Indeed many of the smaller animals, the field-mice, the lemmings, and, Mr Laing conjectures, many of the birds, pass the winter in this climate in a state of occasional torpidity. The wolves are not so dangerous animals as those of the south of Europe. They rarely attack a man, but they will carry off a dog at his side; and they often commit serious havoc amongst the domestic animals. The loss of sheep, calves, cows, and foals, in certain parishes, during the season when they are at pasture, is sometimes immense. Bears also commit depredations of the same kind, but not nearly to the same ex-

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tent, as the wolf, which, when he gets into a herd, bites and tears all that he can overtake. The elk is now very rarely to be met with, and in all likelihood will soon disappear from this part of Europe. It is described as a magnificent animal, being often seventeen hands in height, and sometimes exceeding in size the largest horse. But such splendid specimens are now seldom or never seen. During winter it resides chiefly in hilly woods; but in summer it frequents swamps and the borders of lakes, often going deep into the water to escape the stings of gnats and other insects, and to feed without stooping. With its enormous horns it turns down with great dexterity branches of trees, in order to feed upon the bark; and these are also used as shovels to get at pasture when it is covered with snow. The glutton or wolverine, so called in America, is reckoned a Norwegian animal. Its total length is not more than two feet and a half, and it flies from the face of man. It feeds chiefly upon beasts which have been accidentally killed; but it will hunt small animals, such as meadow-mice, marmots, and the like, and occasionally attack disabled animals of a large size. Although not fleet, it is very industrious, and does great injury to the small fur trade in the northern parts of Europe. The rein-deer, which is found in considerable numbers on the Hardanger Fjelde and the Sogne Fjelde, and the diversified qualities of which are so beautifully adapted to the bleak and inhospitable regions in the north of Norway, will be found described in the article LAPLAND. The beaver, although not extinct, is rare, and lives solitary, not, like the American beaver, in society. A particular kind of dog, with a remarkably fine, soft, and glossy fur, is bred for its skin, which is made into pelisses for winter wear. Besides the wild and tame rein-deer, red deer are pretty numerous in some districts. The fox and the lemming are abundant in some parts, particularly in the north. A multitude of birds inhabit the coasts of the ocean, and Norway furnishes a considerable part of the eider-down, so well known to the luxurious in couches. Game is plentiful; the principal birds being called the tydder, roer, ryper, and jerper. The tydder is the bird known of old in Scotland by the name of capercailzie, but now extinct. The cock is a noble bird, of the size of a turkey-cock, with a bill and claws of great strength. The roer is the female, and in size, plumage, and appearance so different from the male, that it has received a different name in the language. The ryper is the same as the Scottish ptarmigan, but larger and better clothed. Its flavour, however, is inferior to the game of the Scottish hills. But the jerper is a more delicate bird for the table than any of our game. It is of the grouse species, and about the size of a full-grown pigeon. The silence of the forest solitudes is occasionally broken by the sweep of the eagle's or the heron's wing; but the traveller in Norway is generally struck with the limited number of small birds which he meets in the course of his ramblings. Magpies, the Royston crow, and swallows, are common; but the lark, linnet, thrush, blackbird, robin, and some others common to Great Britain, are little known here. Hares and squirrels are in considerable abundance; and there are some other quadrupeds and birds no strangers to the country, but they are of too little importance to require any particular mention. Amongst domestic animals may be mentioned the horse, goat, sheep, and cow; the goose, the duck, and the turkey, which are also found wild. Of horses there is a small breed very general in Norway, and another of a larger size, which is much esteemed for its swiftness and sureness of foot. "These Norwegian horse are beyond all praise," says Mr Laing; "they scamper down hills as steep as a house roof, and in going up hill actually scramble. They have no objection whatever, if you have none, to any path or any pace; they are the bravest of horse kind." They are fed entirely upon hay, which, although merely withered grass, appears to be more substantial than ours, from the wind and powers of the horses which live upon nothing else. The sheep are shaped like deer, having long legs and small muzzles. Numbers of goats and cows are kept, the milk which they yield being very rich, and highly esteemed. Fish abound in the seas, lakes, and rivers of Norway; and the inhabitants not only derive a considerable portion of their subsistence from fishing, bnt it also forms an important article of export. Amongst the insects of Norway, the gnat, or rather mosquito, is found exceedingly annoying. They are in greatest abundance and most venomous in the north. The *furia infernalis*, so called from the dreadful effects which follow from its bite, frequents the marshes or boggy grounds. The acute pain and inflammatory swelling which its bite produces are removed by a curd poultice, which is said to be an infallible cure. The entomology of the south of Norway is very similar to that of the south of England, whilst that of the west resembles the entomology of Scotland.

Climate and soil.

From the general elevation of the land, the climate is of course rendered more severe than would naturally belong to a country under the same parallel the general elevation of which was more nearly on a level with the ocean. The winters are long and very cold; but, as in all northern climates, their length and severity are in some measure compensated by the great heat, and consequently rapid vegetation, in summer. Towards the east, and in the interior, the winter is longest, the cold, generally speaking, always increasing towards the north. The effects of the sea-breezes upon the general temperature of the coasts of all countries are well known. Winter, however, is very pleasant and salubrious; for although the air is cold, it is dry and bracing, not damp and raw. But the western part, especially about Bergen and along the coast, is proverbially rainy, owing probably to the high mountains, which attract the clouds wafted from the ocean. But the country behind this barrier is on that account particularly dry, perhaps somewhat too much so. In Norway the weather is in general more steady than in Britain; it is either good or bad for considerable periods. The summer season is delightful, and very warm. In narrow glens it is too hot during the middle of the day; but the morning, evening, and midnight hours are charming, and peculiar to this country. The sun is below the horizon for so short a time that the sky retains the glow and the air the warmth and dryness, which are as grateful to the eye as they are pleasing to the feelings. Summer lingers long in this country; and, in general, it is an unbroken series of beautiful days. The disagreeable season is the spring, April and May, when, in the transition from winter to summer, the snows are suddenly melted, and the ground is rendered uncomfortable for travelling. Damage is sometimes done by the rapid swelling of the torrents and rivers. When the white covering of winter disappears, vegetation bursts forth at once, and advances with astonishing rapidity.

The following account of the climate of Norway, divided into several districts, is abridged from a popular book of travels.[1] From latitude 58° to 59° the average temperature is about 45° of Fahrenheit, and there is no constant snow region; between 59° and 60° the average temperature is 44°; and between 60° and 61° it is 43° on the sea-coast and 41° in the interior. The mountains of the Hardanger Fjelde and Fille Fjelde lie within this division, and also the great Lake Myosen. From 61° to 62° the average temperature is 40°; a degree farther north

[1] Journey through Norway, Sweden, and Denmark, by H. D. Inglis, p. 262–5.

the heat is about a degree less; and of course it continues to decrease as we proceed towards the North Cape.

The luxuriance of vegetation being abridged by the length and severity of the winter, the soil is thus indirectly rendered comparatively sterile. In America the immense forests are continually enriching the mould with their decaying foliage; but in Norway the paucity of alluvial tracts, the prevalence of rock, seldom far beneath, and often forming the surface, together with the want of vegetable decomposition, materially detract from the quantity as well as the quality of the soil. In some parts it is very rich; and the valleys, in particular, are celebrated for their luxuriant fertility. But much of the soil is thin, and obstructed by rocky knobs rising above its surface, and interfering with the labours of the husbandman. "I have not, indeed," says Mr Laing, "seen in Norway twenty acres of arable land in one field, without some obstruction from knobs of stone." Excepting in the extreme northerly divisions of the country, agriculture is prosecuted with considerable spirit and success.

"In Norway," says Mr Laing, "the trees of the pine tribe are called furu and gran. Furu is our pine (*pinus silvestris*), and gran is our fir (*pinus abies*); the one is the red wood and the other the white wood of our carpenters. There are whole districts which produce only furu, others only gran; and this seems not exactly regulated by latitude or elevation. The zones at which different trees cease to grow appear to be a theory to which the exceptions are as numerous as the examples. In Romsdal amt, at Fanne Fiord, near Molde, in latitude 62° 47′ north, and with a medium temperature of only 4° of Reaumur (41° of Fahrenheit), pears, the bergamot, gravenstein, and imperial, and also plums, come to perfection; and the walnut-tree often bears ripe fruit. Hazel and elm in the same amt form continuous woods, as at Egerdal. Yet the gran disappears altogether, although in the same degree of latitude it grows at an elevation of 1000 feet above the sea in the interior of Norway, and even in latitude 69° in Lapmark. It has been found a vain attempt to raise it in Romsdal amt, a locality in which the following trees and bushes grow readily; Canadian poplar, balsam poplar, horse-chestnut, larch, elder, yew, roses of various sorts, lavender, box, laburnum, white thorn, and ivy. Larch brought from Scotland appears to thrive. There must be something in the nature of the plants not connected with elevation or latitude that determines the growth of the gran and furu." Mr Laing mentions instances sufficiently striking to prove that the "theory of the zones of elevation at which different species of trees will or will not grow must be taken with caution, as it does not satisfactorily cover all the facts observable in this country." In another place he observes, that "wood of considerable size grows as far north as the valley of the Namsen, the largest of the Norwegian rivers, about 120 miles from Drontheim. It grows in sheltered situations in Nordland and Finmark, as far north as Alten Fiord (latitude 70°), but of diminutive size, and in such limited quantity that it is thought necessary to preserve it for the use of the inhabitants, and its exportation is prohibited." Trees in the valley of the Namsen are large enough for building material and the masts of ships. In another place Mr Laing says, "I did not expect certainly to be charmed with the crops in the sixty-fifth degree of north latitude; but the vegetative power, whatever be the cause, is more vigorous here than in the north of Scotland. Some of the largest establishments of saw-mills in Norway are supplied with trees from the forests around the Snaasen Vand. Of ordinary productions, as rye, oats, bear, flax, hops, there appeared to be great crops. This may well be in a soil and climate which raises such noble forests. Behind the house I inhabited is a standard cherry-tree bearing ripe fruit. It would be a rarity in Scotland to raise them unless against a wall, even eight degrees of latitude south of this." Here Mr Laing found hops cultivated as a crop, whilst flax ripened so as to be fit for seed. The mountain and common ash are here scarce; the aspen, wild cherry, birch, and the pine tribes, being the trees, and the juniper, wild raspberry, and wild rose, the bushes, which generally prevail.

Taking the river Namsen as a boundary line separating the productive from the unproductive part of Norway, the country lying to the south of it may be considered as capable of producing, in favourable situations, the grains and fruits of England, and these, too, often in the highest degree of perfection. Most kinds of fruit are abundant, but the greatest favourite is the cherry. The crop of cherries is scarcely ever known to fail; and in proof of the abundance of this fruit, it may be mentioned, that the Norwegians preserve it in great quantities, and use it in many culinary operations. Amongst the fruits growing wild are strawberries, raspberries, cloudberries, cranberries, and various other kinds of berries. The three first mentioned are considered as delicious, and they are eaten both when freshly gathered, like cultivated strawberries, and after being preserved.

Agricultural products.

The principal products of the Norwegian farm are oats, rye, wheat, bear, hops, flax, a kind of bearded spring grain, with potatoes; and a large portion of every farm is set apart to grow grass for the cattle and horses. The grass for the most part is natural, sown grasses for hay being very little cultivated. The land, after a bear crop following potatoes, is left to sward itself with natural grasses for four years, and to form the hay land, so that the proportion of grass to arable land is much greater than in our farms. The natural grasses do not attain any length, and they are shaven as close to the ground as a bowling-green. The fields are not what is called top-dressed, as with us. The scythe in use is much shorter in the blade than that of Great Britain, and it answers the purpose much better. Potatoes, which appear to occupy the place of turnips with us, have been much cultivated since 1812 and 1814, when bad crops, together with the war then raging, reduced many to the use of bark-bread. Large quantities of spirits, called Norwegian brandy, are distilled from potatoes. A small enclosure for hops is attached to every farm-house; but carrots, onions, cabbage, and all garden vegetables, are little used. Probably the short interval between winter and summer allows little time for attending to any but the essential crops. The hop flourishes with little attention under the sixty-fourth parallel; a striking fact, when we consider that this plant is delicate and precarious in the south of England. But there are doubtless families of plants, as there are races of animals, more hardy, or at least more exempt from disease, than others of the same species, and thus enabled to endure the rigours of a stern climate. In farming operations, ditching, draining, and clearing land of vegetable and other obstructions, are prosecuted with great spirit and success. Agriculturists are continually adding to the quantity of arable land in the country by thus redeeming the soil from its original wild state. However, from causes already mentioned, Norway is not capable of furnishing the means of subsistence to any considerable population. Generally speaking, only the glens of the country are inhabited. On the dividing ridges there is little or no cultivation, and indeed no soil to cultivate, but only rounded masses of gneiss and micaceous rocks, with juniper, fir, aspen, birch, and beech, growing where they can amongst the stones.

Mr Laing gives a very minute account of a Norwegian farm rented by a Scotchman; and as he considers it "fitted to be the representative of a large portion of the estates into which this country is divided," we shall abridge his description, retaining all the essential parts. Land in

Norway. Norway is measured by the mæling, which contains forty-nine square ells, the ell containing two feet, and the Norwegian foot being three per cent. longer than ours. Thus the English acre of 43,560 square feet contains four mælings and four tenths. Each farm may be considered as consisting of three divisions. The first is the infield, or what we should call the mains, or home acres, enclosed for the crops and the best hay. The next is the mark or outfield, also enclosed, and affording the out-pasture for the cattle. Parts of it are occasionally fenced off, and broken up for grain, and, when exhausted, are left to sward themselves; so that when the cattle are sent to the Fjelde in summer, some hay is got from the mark. There is often a still rougher piece of ground divided from the mark, as a range for goats and young cattle, called the out-mark. The third division is the seater. This is a pasture or grass farm often at the distance of thirty or forty miles up in the Fjelde, to which the whole of the cattle and dairy-maids are sent for three or four months in summer. The huts on these seaters are substantial buildings, with every accommodation necessary for the dairy; and butter and cheese are accordingly made in very considerable quantities. When speaking of farms of so many mælings, the seater and mark are not included in the measurement, but thrown in as appendages. "The farm of my countryman," says Mr Laing, "consists of 1276 mælings, or 290 English acres; but this does not include the seater, which happens here to be on the hills immediately behind the farm, is covered with fine trees, and is of a defined boundary, extending about a Norwegian mile (seven English miles) in circuit. On the measured land 148 acres are cleared; but, being farmed in the Norwegian style, one third only bears crops of corn and potatoes. The remainder is always in grass or hay, for the winter support of the cattle. It is natural grass, not top-dressed with manure, and is mown when not above the length of one's finger, so that the proportion of arable land that must be given up to keep the cattle in winter is enormous. It is the system of farming in this quarter; 142 acres outside of the 148 infield are half cleared, being fenced off and ploughed in patches. It bears good grass, but is encumbered in some places with brushwood and stones."

"This farm supports twenty cows, seven horses, and a score or two of sheep and goats. The accommodation for cattle is excellent. They stand in a single row in the middle of a wide house, with partitions between each, and room before and behind greater than is occupied by the animal itself. The cow-house is lighted by glass windows on each side. The cattle stand on a wooden floor, below which is a vault, into which the dung is swept by a grated opening at the end of each stall." All the cow-houses in Norway are constructed on this large and convenient scale; and neither cows nor horses require litter, which is a great saving of fodder. Besides, they are kept perfectly clean, with comparatively little trouble. The annual rent of this farm was two hundred dollars, or L.37. 10s. sterling, and the amount of taxes paid was L.6. 14s. 5s., nearly one sixth of the rental, which appears very heavy. But this is nearly all that is paid in any shape; the indirect taxes, such as our excise and custom-house duties, being inconsiderable. It includes tithe, and all charges connected with the church establishment, poor rate, and so forth. Such a property as that now described is considered worth about 4000 dollars. From 2500 to 4500 dollars include, it appears, the prices of all ordinary estates, and any thing very much above or below would be an exception to a general rule. As to the dwelling-houses on such estates, the material for building is so easily obtained that there is really no difference between the residence of a public functionary, of a clergyman, or of a gentleman of large property, and that of a bonde or peasant proprietor. The Norwegians are the best lodged people in Europe, Mr Laing says; but there is little show, and no magnificence which can well be dispensed with in such a country. The division of property among children prevents the erection of splendid mansions, or any thing more expensive than is proportioned to the property upon which they stand. The harvest work in this district," continues our traveller, "and I believe all over Norway, is well done; and parts of their management might be adopted with advantage in our late districts, where so much grain is lost or damaged almost every autumn by wind or rain. For every ten sheaves, a pole of light strong wood, about the thickness of the handle of a garden rake, and about nine feet in length, is fixed in the ground by an iron-shod borer; it costs here almost nothing. A man sets two sheaves on the ground against the stem, and impales all the rest upon the pole, one above the other, with the heads hanging downwards." This is certainly a mode very superior to ours; and they have likewise a better way of cutting it, by which little of the grain is lost. But for an account of this process, and other farming operations, we must refer to Mr Laing's work (pp. 96, 106).

The breed of cattle in Norway is fine boned, thin skinned, and kindly looking; the colour is generally white, sometimes mixed with red, but seldom entirely black. The head and muzzle are as fine as in our Devonshire breed. There is so little coarseness about the head or neck of the bull, that the difference between him and the ox is less observable than in our breeds. The cattle are all very carefully attended to, and form an important branch of the husbandry, as dairy produce enters much into the food of every family, and is more certain in this climate than that of grain. The cows, sheep, and goats are more tame and docile than they are in Britain, from the constant care and attendance bestowed on them during the long period which they must stand within doors; and the Norwegians are remarkably kind to their domestic animals. Goats are a favourite stock, and on every farm appear to be much more numerous than sheep. The goat will eat and thrive on the shoots of the dwarf birch, beech, and young fir; but the sheep will not, and in winter it requires some hay. The goat then gets a bundle of dried leaves and shoots of the beech, which only cost the trouble of collecting and drying them. Every farm-house at this season is surrounded with bundles of these withered branches and leaves of beech tied together, and stuck upon poles to dry. The goat, too, gives some milk in winter, when that of cows is scarce; and from the uncommon richness of milk in Norway, this small quantity can bear to be increased with water, without materially deteriorating it.

Irrigation is carried on in many parts to an extent quite unknown in this country. Hay being the principal winter support of live stock, and both it and corn, as well as potatoes, being liable, from the shallow soil and powerful reflection of sunshine from the rocks, to be burned and withered up, the greatest exertions are made to bring water from the head of each glen, along such a level as will give the command of it to each farmer at the head of his fields. This is done by conducting water in troughs made of the half of a tree roughly scooped out, from the highest perennial stream amongst the hills, through woods, across ravines, along the rocky and often perpendicular sides of the glens; and from this main trough lateral branches shoot off to each farm. The farmer distributes this supply by moveable troughs amongst his fields, watering each rig successively. The quantity of land traversed by these artificial water-courses is very great.

In winter, when agricultural operations are suspended, the Norwegian employs himself in making all the implements, furniture, and clothing, which his family may require; thrashing out the crop, attending to the cattle, distilling his potatoes, brewing, driving about to fairs, or paying visits. The heaviest of his occupations is driving wood out of the forests, or bog-hay from the Fjelde, where it is made in summer by those who attend the cattle. The distillation of spirits from potatoes is general throughout Norway, grain not being in such abundance as to allow of its consumption in this way. By far the greater part of the spirits used in the country is made in families, not in regular distilleries; every common bonde, or peasant proprietor, distilling his own few barrels. It is part of the women's work, like cheese making or brewing, and is carried on once a week or once a fortnight, on every gaard, for the sake of the wash and refuse to the cattle, as well as for the spirits. The most profitable way of distilling potatoes," says Mr Laing, " is with a mixture of crushed wheat and malt, or, instead of wheat, rye or any other kind of grain. The best proportions are these :— To six heaped barrels of potatoes, weighing seventy-eight stones of sixteen pounds each, nine and a half stones of wheat or other corn, and five of malt from bear or big. If more of any of the parts be taken, the wort or liquor to be distilled is too heavy, and is apt to burn or singe in the still. By this proportion the smallest distilling, as a barrel or half a barrel at a time, is regulated. The crushed grain and malt are first mixed in about a hundred and twenty quarts of water, heated to 50° of Reaumur, or 144° of Fahrenheit, and no higher. The potatoes being perfectly steamed (brought to such a state as to be fit for eating), are crushed between two rollers, and, as they leave the rollers, are shovelled into the vat in which the fermentation is to take place." " Boiling water to the extent of about four hundred and fifty quarts is then poured into the vat, and is cooled down with cold water to 20° Reaumur, or 77° Fahrenheit, at which the mash of wheat and malt is added to it; the vat is then immediately covered up as tightly as possible, and left to ferment." After fermentation has ceased, distillation immediately commences, the process being conducted in the usual way. Somewhat more than eighteen quarts English, of a strong fiery spirit, destitute of any disagreeable taste or smell, is produced from the barrel of potatoes. Of its exact strength Mr Laing was unable to form any judgment.

In Norway there is no restriction on mills, every man who chooses having a right to erect one, without entailing upon himself any feudal burden, such as service, suit, or feu, for he is the superior of his own lands. These mills are very numerous in the country, being not only necessary to almost every farm, but for sawing timber for exportation, as well as for home consumption.

The thrashing machines in general use amongst agriculturists are similar in construction to those of Scotland; and some have grinding machinery attached to them. There is an institution of a very peculiar nature, which is quite common all over Norway. In this country there are no merchants equivalent to our corn-dealers, nor are there any weekly markets held for the sale of grain. There are no middle-men between the grower and the consumer, and any surplus grain which the farmer may have is stored up in what may be called corn-magazines, which are just large warehouses erected in various parts of the country, as the necessities of the inhabitants require them. What grain the farmer thinks he will not require he conveys in sledges to these places, and for every eight bushels which he deposits, he receives nine at the end of twelve months; in short, he lays it out at interest, and has an increase of one eighth per annum. If, however, he has none deposited, or overdraws, he pays for the quantity received in loan at the rate of one fourth of increase per annum; so that for every eight bushels which he takes he pays back ten at the end of twelve months, or at that rate for whatever time he may have the loan This is, in fact, a savings' bank for corn, and is probably the most ancient of these institutions. There being no corn-merchants is decidedly a material check upon the prosperity of agriculture; for, from the want of a ready market where he might dispose of his produce, and the consequent comparatively small inducement which he has to store it up in these magazines, the farmer naturally wastes it, or does what is probably worse, distils it into ardent spirits. But these institutions are exceedingly useful to the Norwegians as they are circumstanced; and were it not for them, many might be placed in great difficulties, for want of seed or bread when a bad season disappointed their hopes of a supply from their own fields. The small profit which occurs upon these transactions defrays the necessary expenses of building and keeping up the magazines, which are entirely under the management of the bonder or peasant proprietors. However, under such a system, husbandry can never become what it is in Great Britain, a manufacture of corn, beef, and other provisions, carried on by a class of individuals who pay a very high rent for the premises on which they work, and embark large capitals in the business. In Norway the bulk of the farmers have no rent to pay, the property being their own; the articles which their farms produce constitute nearly the whole of the food or raiment which they and their people require; and there are not, as in other countries, considerable masses of population in towns and villages, who, not being producers of food themselves, must obtain it from those who are; so that the farmer is less dependent upon money-bringing crops than is the case with us. If he raise what is sufficient for his own household consumption, with a little surplus for sale to pay the taxes, and for the purchase of a few luxuries, all the purposes of farming are served with him. This is partly owing to the state of property in Norway.

State of property.

Property in Norway is held by what is called the udal or odel system of rights, not from any superior, not even from the king, but, as the possessors proudly express it, by the same right by which the crown itself is held; consequently there is no acknowledgment, real or nominal, as feu-duty or reddendo, paid. In this country all lands are theoretically said to be held from the king; and, according to Sir Edward Coke, we have no allodial lands. In Norway estates are allodial, the absolute property of the owner; they are therefore possessed without charter, and are subject to none of the burdens and casualties affecting land held by feudal tenure direct from the sovereign, or from his superior vassal. There is, in short, a total negation of the feudal principle; there is neither superior nor vassal, so that the military service which the latter paid to the former in consideration of the land which was granted appears never to have existed in Norway; and as this constituted the foundation of the law of primogeniture, so, where such service was entirely unknown, there was no necessity for that law, which consequently remained equally unknown. In all feudal countries the eldest male heir has to pay an acknowledgment to the feudal superior on his entering as vassal in the land. But udal, or noble land, as the word signifies, not being held for military service to a superior, no *delectus personæ* as to who should inherit it was competent to any authority, and consequently no preference of the eldest male heir could grow into the law of succession to land. Hence the land came to be equally divided amongst all the surviving children, male and female. There appears, however, to be a species of entail connected with the udal tenure. If the udalman in possession should alienate to a stranger, the next of kin has a right of redemption on paying the price of the land. This is called the Odelbaarn's Ret, and all the kindred of the udalman in possession

Norway.

are what is called Odelsbaarn to his land, or, in other words, have a certain right in the order of consanguinity. By recent enactments, this right of redemption has been limited in its exercise to a period of five years; and it is provided that all improvements, as well as the original price, must be paid for.

The equal partition of property amongst children by the udal tenure has prevented the accumulation of property in large masses; but, as might have been expected by theorists, it has not led to subdivisions of estates to an injurious extent. "The division of the land appears not," says Mr Laing, "during the thousand years it has been in operation, to have had the effect of reducing the landed properties to the minimum size that will barely support human existence. I have counted from five and twenty to forty cows upon farms, and that in a country in which the farmer must, for at least seven months in the year, have winter-houses and provender provided for all the cattle. It is evident that some cause or other, operating on aggregation of landed property, counteracts the dividing effects of partition among children." In another place Mr Laing says, "The estates of individuals are generally small; and the houses, furniture, food, comfort, ways and means of living, among all classes, appear to me to approach more nearly to an equality to one standard than in any country in Europe. This standard is far removed from any want or discomfort on one hand, or any luxury or display on the other. The actual partition of the land itself seems, in practice, not to go below such a portion of land as will support a family comfortably, according to the habits and notions of the country; and it is indeed evident that a piece of ground without houses upon it, and too small to keep a family according to the national estimation of what is requisite, would be of no value as a separate property. The heirs accordingly either sell to each other, or sell the whole to a stranger, and divide the proceeds. The duty of the Sorenskriver, or district judge, consists chiefly in arranging this kind of chancery business, and all debts and deeds affecting property are registered with him."

The cause which, according to Mr Laing, has prevented excessive subdivision, is, "that in a country where land is held, not in tenantry merely, as in Ireland, but in full ownership, its aggregation by the deaths of co-heirs and by the marriages of female heirs among the body of landowners, will balance its subdivision by the equal succession of children." This is undoubtedly true, and, when taken in connection with other facts, may sufficiently explain the case. Mr Laing informs us that the standard of living is high in Norway; or that the population is much better clothed, lodged, fed, and generally provided for, than our labouring and middling classes in the south of Scotland. The dwelling-houses of the meanest labourers are divided into several apartments, and have wooden floors and a sufficient number of good windows, with some kind of out-house for cattle and lumber. Their food and clothing are equally good and substantial. Now it seems quite clear that a people habituated to such a standard of subsistence and comfort will not only not suffer their condition to sink indefinitely below it, but, by prudence and foresight in the contraction of marriage and the raising of a family, will keep down their numbers considerably within their means of subsistence. In Norway that condition which secures respectability to a common man, is one in which he commands not only all the comforts, but most of the luxuries of life, common to the country; and the natural desire of all mankind to keep up caste, to maintain themselves in that station in which they were born, not to decline from it, and fall, as it were, out of the ranks, will operate as a most powerful check upon the minute subdivision of land. There are other causes in operation to which our circumscribed limits will only admit of our adverting. These are the ancient and confirmed habits of the people, which may be taken into account as a corollary of the preceding proposition; and the absence of impediments, such as fines on alienation, or imposts of any kind, in the way of sale or conveyance. Where such fines exist, the difficulties of re-uniting land which has been subdivided are great and annoying. But in Norway, when an udalman dies, the co-heirs do not break up the estate left to them into six or eight, or any other number of estates, corresponding to the number of children; which would at once reduce the standard of living of the whole of them below that to which they were accustomed. They appear either to sell to each other, which is easily effected in the absence of fines and other burdens on conveyance of property; or they make a joint-stock business of it, till circumstances permit some of the members to dispose of their shares to those who may remain, and employ the capital in such an advantageous manner as will secure them in that comparative independence and affluence to which they were all their lives accustomed. The diffusion of property in Norway is no doubt very great, compared with its diffusion in this country, but not as compared with Canada. The following table will facilitate comparison:

Country.	Population.	Proprietors.	Proportion of Proprietors to Population.
Scotland........	2,093,456	8,961	1 to 222
Norway..........	910,000	41,656	1 to 22
Lower Canada..	512,000	57,891	1 to 9

These small estates are scattered on the sides of glens, lakes, and fiords, over a vast extent of country, and, generally speaking, are situated at great distances from towns.

There are two classes of landholders in Norway; those who have farms larger than they themselves can cultivate, and those who exclusively farm their own estates. These constitute the bulk of the population. The first are called proprietors, a sort of conventional term, equivalent to our esquire; the smaller landholders who work upon their own estates are called *bonder*, a term, as appears, nearly equivalent to feuar in Scotland. The incomes of the former seldom exceed eight hundred or nine hundred dollars, although there are some who possess as much as three or four thousand pounds sterling per annum. The Norwegian valleys are crowded with bonder farms, which are very numerous throughout the country, and, with their look of plenty and completeness, may compete with the richest and most beautiful in Scotland. Mr Laing draws a very pleasing and interesting picture of this class of people, whose comfort and happiness may indeed be inferred from a short statement of facts. They are owners of their own little estates, which produce all the necessaries of life, and afford a surplus for the payment of taxes and the purchase of luxuries. They have no feu-duty nor other incumbrance on their property, except the scot or land-tax, which, although heavy, renders every thing used by a family so much cheaper, the indirect taxes being little or nothing. They are exceedingly well lodged, and the families live abundantly; the manner of living, indeed, is pretty much the same amongst all classes. These, and the comfortable assurance, that in case of death the udalman leaves his wife and family provided for, are certainly calculated materially to promote human happiness. "This class," says Mr Laing, "are the kernel of the nation. They are in general fine athletic men, as their properties are not so large as to exempt them from work; but large enough to afford them and their households abundance, and even a superfluity, of the best food.", Besides the bonder or agricultural class, properly so called, who occupy all the most fertile lands in the country "from the shore-side to the hill foot," whereon corn will grow, there is another class called Fjelde bonder, who form a connecting link, as it were, between the class above described and the wandering Laplander. They also possess land, and have houses, which, although small, are comfortable; but being above the level of the corn growing country, their situation is not so favourable, nor is their condition equal to that of the other small proprietors. The Fjelde bonder are "the hewers of wood and drawers of water" in Norway; but they still possess property in cattle as well as in land, and they are described as extremely hardy and active, and as having more robust frames than the agricultural bonder. There is yet another class of the population, which is altogether distinct from any of the preceding, consisting entirely of fishermen, whose social condition must be considerably inferior to that of the others.

In the provinces of Nordland and Finmark, which occupy the northern part of Norway, beyond the river Namsen, agriculture is but a secondary business, and fishing may be said to occupy most of the attention of the inhabitants. The crops of grain are too inconsiderable and precarious to afford them the means of subsistence, and the riches of the deep are brought in as a compensation for the poverty of the land. The winter fishery in the Lofoden Islands, from the middle of February to the middle of April, and the summer fishery over all the coast, which in some branch or other gives employment for the remainder of the year, furnish the inhabitants with the means of purchasing the necessaries which they require. The fish trade is a very curious monopoly. It does not belong to Norway as a whole, but is in the possession of Bergen, Drontheim, Christiansand, and one or two other towns of minor note. Those who manage the business as merchants or shop-keepers, are licensed burgesses of these towns; and each has a certain tract of coast or circle belonging to his shop or factory, within which no other person is entitled to buy or sell. These privileged traders pay a certain tax, and are besides obliged to receive and entertain travellers; and their exclusive privilege has become hereditary, attached to the house or factory in which it may be exercised by a duly privileged trader. The average value of the winter fishery has been estimated at L.86,500 sterling; and as the number of inhabitants in the two provinces is only about 80,000, the trade of Nordland and Finmark with the rest of Norway is at the rate of little more than twenty shillings a head. The merchants send out vessels furnished with articles required in the country, and receive the produce of their eight weeks' fishery in payment. In fact, these distant provinces are connected with the rest of the country for just two months in the year, and that only through a few merchants in two or three towns. During the other ten months the trade is left entirely in the hands of the Russians, who feed the population, and receive in return all that their industry produces in the fishing. The privileged Norwegians take no more brandy, colonial produce, or such other articles as are wanted, than what is sufficient to pay the persons who fish for them for eight weeks; their further supplies the inhabitants obtain from Russia. Were the trade free to all the natives of Norway, as it is in every country where trade has flourished, there would have been a body of Norwegian traders to and from these provinces, carrying on every branch in which employment and profit could be found and realized. Instead of this, the business is almost entirely in the hands of strangers, and Norway receives little or no benefit from her own possessions. To the absurdity of such a monopoly it would be difficult to find a parallel in the history of commercial restrictions.

The fishing business itself is conducted in a peculiar manner. Every twenty or thirty of the fishing companies have a yacht, or large tender, which conveys the provisions, nets, lines, and other articles, to the Lofoden Islands, the great scene of the Norwegian fishery, and brings back the produce. The stations are all correctly defined by marks on the coast, and by judicious regulations confining line-fishers to the inside, and net-fishers to the outside. In 1827, which was a medium year, there were 2916 boats fishing in eighty-three different stations, accompanied by 124 yachts or tenders, the number of men employed being 15,324 in all. The produce was 16,456,620 fish, which would amount to about 8800 tons dried; there were also 21,530 barrels of cod oil, and 6000 of cod roe. When this fishing ends, the seafaring peasantry of this part of the country, as we have already said, are employed by the Russians; the others return to their homes, and catch sethe (*gadus virens*) or herrings. The herring fishery is very judiciously managed; so much so, indeed, that the Norwegians have beaten the Scotch herring curers out of the markets of the Baltic, as they deliver fish better assorted, and of superior quality. Besides these important general fisheries, there is in every creek of the fiords, even at a hundred miles up from the ocean, abundance of cod, whitings, haddocks, flounders, sea-bream, and herrings, caught for daily use and for sale by the seafaring peasantry. The rivers and lakes are likewise well supplied with fish, which may indeed be said to constitute the basis of a Norwegian repast.

Trade and manufactures.

The manufactures of Norway are too unimportant to detain us long. Wood and fish are the chief produce of the country; and these find their way to every part of Europe, chiefly in Norwegian vessels, which in return bring home whatever foreign articles are required, at the cheapest possible rate of freight. The import duties are very moderate. Articles which have been in use, and are not intended for sale, as furniture, books, clothes, or household goods, are not subject to duty. Before the importer pays his duties, he is allowed to take his goods to his own warehouse and shop, upon giving security for the amount of the duties ascertained by the custom-house officers at landing; he also keeps an account of his sales, and pays the duty every three months upon the quantity which appears to have been sold. This must be of great advantage to the dealer in a country so poor as Norway, since it leaves his capital entirely free for active employment. Coffee, sugar, tea, a little French brandy, and French and Spanish wines, a little tobacco, (for the Norwegians smoke less than any other continental people), and a limited quantity of spiceries, are the principal articles for which the house-keeper has to disburse money. The other necessaries of life are produced by themselves. Shoes, furniture, cloths, and the like, are all made at home. Looms are at work in every house in the country; carding, spinning, and weaving forming constant occupations of the female part of the household. Woollen cloth, substantial but coarse, excellent bed and table linen, and checked or striped cotton or linen for female apparel, are the ordinary fabrics produced. These home-made stuffs, including boots, gloves, and in bad weather great-coats, clothe the greater part of the inhabitants, and more comfortably than is the case with the lower and middling classes of people in most other countries. The upper ranks, or the people of condition, dress as in other parts of Europe; and as living and lodging are nearly on a level amongst all the respectable classes, the peasant proprietor, and those more wealthy than he is, this wearing of foreign articles by the latter, and home-made stuffs by the former, would seem to constitute a kind of conventional distinction between them. This is not the place to speculate on the general economy of these family manufactures; it seems, however, to be extremely well adapted to the Norwegians,

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as they are circumstanced, both in regard to climate and social relationship.

The principal articles of export are timber, bark, iron, copper, fish, and some others. The principal articles of import are corn, colonial produce, woollen, linen, and cotton goods, wine, brandy, &c. Salted and pickled fish, one of the staple products of Norway, is principally exported from Bergen. In the year 1833, there were exported from this place, of dried fish or stock fish, 22,620,992 pounds, and of salted and dried fish 4,802,000 pounds. The deals of Christiania have always been held in the highest estimation; a consequence of the excellence of the timber, and of the care with which the sap-wood and other defective parts are cut away. Like many other branches of the trade of Norway, that of preparing wood was formerly fettered by pernicious restrictions; the saw-mills being licensed to cut a certain quantity only, and the proprietors bound to make oath that it was not exceeded. But this absurd regulation no longer exists. British manufactured goods are admitted into Norway on moderate duties, and are very generally made use of. The imports from Norway were,

	In 1831.	In 1835.
Bark for tanning and dyeing...	48,131 cwts.........	20,043 cwts.
Iron	377 tons.........	4 tons.
Goat-skins..........................	18,219 number	7,837 number.
Smalts	206,840 lbs...........	90,563 lbs.
Battens and batten ends........	8,439 grt. hund ..	5,415 grt. hund.
Deal and deal ends..............	10,457 do. do.....	4,704 do. do.
Masts, yards, and the like,.... under twelve inches.........	4,826 do. do.....	6,842 do. do.
Timber................................	23,527 loads........	30,446 loads.

These are the principal articles; but there were some others, amongst which may be reckoned one million of lobsters. The exports to Norway were,

	In 1831.	In 1835.
Coffee	535,491 lbs............	310,459 lbs.
Indigo	7,765 lbs................	8,631 lbs.
Pepper	8,189 lbs................	1,920 lbs.
Pimento....................	4,981 lbs................	4,348 lbs.
Rum....	4,585 galls..............	6,248 galls.
Muscovado sugar........	3,169 cwts...............	1,298 cwts.
Tobacco................	366,024 lbs............	475,338 lbs.
Cotton wool............	83,566 lbs	39,227 lbs.
Coal........................	3,774 tons	5,602 tons.
Cotton cloth...........	434,744 yards..........	691,320 yards.
Earthenware..........	L.3,402	L4,502
Cutlery.................	L.2,648	L.3,646
Soap and candles......	L.2,938	L.3,302
Woollens..............	L.13,000	L.17,229
Salt.......................	92,150 bushels.......	147,057 bush.
Wheat	....	1,283 qrs.
Barley.......................	....	24,471 qrs.

In some articles our trade with Norway has declined, but the amount of British and Irish produce and manufacture exported to that country has steadily increased, as the following statement will show. Our exports were, in 1827, L.39,129; in 1828, L.53,582; in 1829, L.64,234; in 1830, L.63,926; in 1831, L.58,580; in 1832, L.34,528; in 1833, L.55,038; in 1834, L.61,998; and in 1835, L.79,278.

Were the discriminating duty on Norwegian and Baltic timber repealed, our commercial relations with the whole north of Europe would be greatly extended. Compared with the Swedish customs-duties, those of Norway are moderate, the import duties seldom exceeding two per cent. *ad valorem.* In 1831 they amounted to L.161,840 inwards, and to L.47,381 outwards, making in all L.209,221. To these should be added L.27,436 received on account of tonnage duties, lights, and sundries. The weights and measures of Norway are the same as those of Denmark.

With regard to money, the principal silver coin in circulation (for there are none of gold) is called a species dollar, which is divided into one hundred and twenty skillings. There are also half species, one fifth species, one fifteenth species, and what is denominated skillemynt or small change, that is, four and two skilling pieces of silver, and also one and two skilling pieces of copper. The dollar is worth three shillings and tenpence sterling at the present rate of exchange (1837). There are, besides, notes of one dollar, half a dollar, and twenty-four skillings, all printed on white paper. The notes of five dollars value are on blue paper, those of ten dollars on yellow paper, and those of fifty on green paper. This is, we think, a very wise and convenient arrangement.

The Norwegian finances are in a flourishing condition, the revenue having latterly increased considerably. The Bank of Norway, which was founded in 1816, has its head office in Drontheim, with branches in the principal towns, and is under the direction of five stockholders, with a council of fifteen representatives of the other proprietors. The transactions of this bank are conducted upon a principle totally opposite to that of the Scotch and other banking establishments. It is there considered as a first principle that the bank should hold only available securities, as bills or bonds at a short date, or payable at a short notice, for its issues or advances. The national bank of Norway is therefore a bank for landed property, and discounts mercantile bills and personal securities only as a secondary branch. Its chief business is advancing its own notes, upon first securities over land, any sum not exceeding two thirds of the value of the property, according to a general valuation made in the year 1812. The borrower pays four per cent. for what he draws, and is bound to pay also five per cent. of the principal yearly. This kind of bank is exceedingly well adapted for the wants of the country; and their paper can scarcely be considered as less secure than their silver. Since it commenced business, discussions have more than once taken place regarding the return of the bank to cash payments, as it was originally agreed that after the lapse of a certain period it should begin to pay its notes in cash. This has not been found practicable, although the maximum has been reduced to 125 paper dollars for 100 of silver; but the paper dollar has for a considerable time been at 112 for 100 silver on the exchange of Hamburg. The bank is able to provide for all its notes in silver; and the question recently agitated in the Storthing was, whether its course of 125 paper for 100 silver dollars should not now be reduced to par, 100 paper for 100 silver, which has not been agreed upon.

The Norwegian army consists of some twelve thousand troops of all arms, besides which there are thirty thousand militia enrolled. Two companies belonging to each regiment in the Norwegian service are trained to the use of the skidor or skate. This corps, called the skielöbere, move with singular agility and speed, and, whilst skating along with the greatest velocity, perform their military evolutions with uncommon precision. The army is at the disposal of the king, as far as its services can be rendered available in Scandinavia; it cannot, however, be sent beyond the limits of the peninsula without the special permission of the Storthing. The king has the nomination of the superior officers of the army, as well as of some few of the first civil officers under the government; that of others rests with the Storthing. Norway is governed by a viceroy, appointed by the king of Sweden; Christiania, the capital of the country, being the seat of government. She contributes nothing towards the expense of the Swedish government beyond a trifling annual allowance to the royal family; but she supports all her own civil and military institutions.

In the year 1825 the population of Norway amounted to 967,959. According to the census of 1835, it was 1,098,291, being an increase of 130,332 in ten years. The town population of 1825 was 112,778, and in 1835, 125,139, being an increase of 12,361 in the same period; and that of the country amounted in 1825 to 855,181, and in 1835 to 973,152, being an increase in ten years of 117,971. It is quite clear, therefore, that the great bulk of the population is engaged in agricultural pursuits; trade, manufactures, and the other occupations employing but a very limited number. The town population is confined to thirty-eight places, only nine of which have more than 3000 inhabitants, and only two reach 20,000. Besides, in the whole of these, with the single exception of Bergen, a considerable proportion of the inhabitants are partially engaged in agriculture. During these ten years, no manufacture has been produced fit to be exchanged for the commodities of other countries. The staple trade in wood, which formerly gave employment to a large portion of the inhabitants, has latterly been in a very depressed state, from the restrictive duty already referred to. The increase of population, therefore, has chiefly taken place amongst the agricultural classes; and the additional food raised for their support, together with the admitted advance of the people during these ten years, is to be attributed partly to additional tracts of land having been taken in, and partly to improved methods of cultivating the old soil. The country has unquestionably made great progress under its own peculiar legislation; and taxes have gradually been reduced.

The kingdom of Norway is divided into four sees or stifts, each of which is divided into a certain number of districts, corresponding to its size and importance, and these again into parishes, of which there are 336 in the country. The dioceses are Aggershuus, containing Christiania, the capital; Christiansand, the largest town in which bears the same name; Bergen, containing the large and important city of the same name; and Drontheim, which contains the city of Drontheim, situated on the south shore of a great fiord of the same name; the northern territories of Nordland and Finmark, which goes also by the name of Drontheim, being presumed to be in the same see. The stifts are thus distributed. Christiansand occupies the southern extremity of the country; Bergen and Aggershuus occupy, the former the western, and the latter the eastern side of Norway, where it is widest, extending over its whole breadth in that quarter, and being separated by the great mountain chain; still farther north lies Drontheim, which is succeeded by Nordland and Finmark, the most northerly region of Norway, and of which the reader will find some account in the article LAPLAND. Each district, called a fogderie or bailiwick, is under a foged, who has charge of the collection of taxes, police, and all executive functions in his district. Besides this public functionary, there are military officers, who have official residences in the district; and the amtman, and sorenskriver or judge ordinary. Christiania, Bergen, Drontheim, and the other large towns in Norway, will be found described each under its own respective head in this work.

The Norwegians enjoy more political liberty than any other European nation. The parliament, called the Storthing, is chosen by the owners or life-renters of the land who have attained the age of twenty-five years complete. The minimum value which gives a vote is a hundred and fifty dollars, or L.30, a value which, from the large diffusion of property, renders the suffrage nearly universal. To render the elector himself eligible as a representative, it is only necessary that he should be thirty years of age, have resided ten years in Norway, and be altogether unconnected with the state. The voters choose electing men, one to every fifty voters in towns, and one to every hundred voters in counties. The elective franchise is not connected with the place, but with the number of electors; and expands or contracts as they increase or diminish. If numbers change, the power of choosing electing men changes also; and as the Storthing bears a proportion to the number of electing men, the number composing the Storthing likewise varies; but the variation cannot be great, indeed seldom more than two or three. By this self-acting system of parliamentary reform, places which increase obtain a direct voice in the making of laws, whilst such as decrease below fifty electors must join another district. The electing men, on a day fixed by law, choose their representatives, and the body thus elected forms the Storthing. The proportions of members chosen is founded on the principle, that the towns in Norway should as nearly as possible return one third, and the country two thirds, of the whole body, which must not consist of less than seventy-five, nor of more than one hundred members. Each district elects as many substitutes as it elects representatives, to provide against death and other casualties. The Storthing is chosen every three years, and is assembled only once in three years, when it sits for three months, or until the business be despatched. The 1st of February is the day of meeting fixed by law. An extraordinary Storthing may be convened by the king, but its acts must be confirmed by the next regular Storthing. After some preliminary business, such as electing a president, speaker, and secretary, the Storthing divides itself into two chambers. One fourth of its whole number is formed into a second chamber, called a Lagthing, or division, in which the deliberative functions of the legislative body are vested. This chamber appears to be equivalent to a house of peers, but its powers are much more confined. No bill can be introduced there; it must come from the other house, which is called the Odelsthing, or house of commons. The Lagthing can only deliberate upon what is sent to it, and approve, reject, or send back the bill with proposed amendments. It is also the court before which, aided by the Hoieste Ret Court, an independent branch of the state, the lower house may impeach ministers of state. As the Storthing of 1836 consisted of ninety-six individuals, the Lagthing comprised twenty-four members, and the Odelsthing seventy-two. Mr Laing thus speaks of the Norwegian parliament. "The Storthing consists, in fact, of three houses, the Lagthing of twenty-four members, the Odelsthing of seventy-two, and the entire Storthing consisting of the whole ninety-six united in one house. In this latter all motions are made and discussed; and, if entertained, are referred to committees to report upon to the Storthing. The report, when received back from a committee, is debated and voted upon; and if approved, a bill in terms of the report is ordered to be brought into the Odelsthing. This house entertains or rejects the proposed bill, frames and discusses the enactments if it is not rejected *in toto*, and sends it up to the Lagthing or upper house, to be deliberated upon, approved, rejected, or amended." In regard to the passage of bills through these two houses, the practice of the Norwegian parliament does not differ materially from that of our own, except in the more limited functions of the Lagthing, the king having only a suspensive veto. But if a bill pass through three successive Storthings, it becomes the law of the land without the royal assent. This was exemplified in the case of the bill, already mentioned, for the abolition of hereditary nobility. The duties of the Storthing need not be minutely specified; they may easily be inferred. The members are paid for their services; and no executive officer of government can sit in either house.

For legal purposes, the whole country is divided into four stifts or provinces; and these are farther subdivided into sixty-four judicial districts, each of which last compre-

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Jurisprudence.

Norway. hends several prestigilds or parishes. To each of these divisions there is a distinct tribunal, with a supreme court of ultimate appeal for the whole kingdom, established at Christiania. The lowest court, which is strictly one of equity, not of law, is the court of mutual reconcilement or agreement held in every parish, and over which presides a commissioner, who is elected every three years by the householders, and holds his court once a month, receiving a small fee. Every case or law-suit whatsoever must pass through this preliminary court, where no lawyer or attorney is permitted to practise. Each party states his own case; and if by the judgment or advice of the commissioner the parties are brought to agree, his opinion is duly registered in another court held in the parish, and it has all the validity of a final decision. If, however, the litigants are not satisfied, they carry their case to the lowest legal court, that of the sorenskriver, or sworn writer, which is held in every parish of every district once in every quarter. The sorenskriver's court is of great importance. Besides judging civil and criminal matters, it is the court of registration affecting property in the district, and also for ascertaining the value of and succession to the property of deceased persons. The court next above is the stift-amt court, or that of the province, and is thus constituted. It consists of three judges with assessors, is stationary in the chief town of each province, and is the court of appeal from all the lower tribunals of the province, having at the same time the revision of their administration. It must likewise sanction their decision in criminal matters before sentence can be pronounced. There is, lastly, the Hoieste Ret Court of final appeal. It consists of seven judges, and, by the ground law, is one of the three estates of the constitution, being independent of the executive and legislative branches. To this court appeals are carried in the last resort, from the stift-amt courts, in criminal as well as civil cases.

The Norwegian system of jurisprudence presents some remarkable features, not the least important of which is that the judge is responsible for his legal decision; and in a case of appeal to a higher court, he must there defend his judgment, being liable in damages for a wrong decision. This principle involves a high responsibility, and must occasion some individual annoyance, as well as expense; but it does not prevent able lawyers from becoming candidates for judicial functions; and beyond all doubt it is of great advantage to the public in giving certainty to the law, and in preventing as well as remedying erroneous decisions. The punishment of death was abolished by the Danish government about the latter end of the last century, a measure of questionable expediency in this country, at least where the secondary punishments are by no means perfect. But the punishment which is found the most effective, and which forms one of the most distinguishing characteristics of the country, is that of the "loss of honour." From the earliest times this has been a specific punishment in the criminal law of Norway, standing next in degree to the loss of life. "The possession of property," says Mr Laing, "naturally diffuses through all classes the self-respect, regard for character and public opinion, circumspection of conduct, and consideration for others, which flow from and are connected with the possession of property, and render these influential on the morals, manners, and mode of thinking of the whole body of the people." There is and has always been much more of the real business of the country in the hands of the people of Norway, and transacted by themselves, than is possessed by the inhabitants of any other European nation. Now, as the "loss of honour" involves exclusion from all the functions which naturally devolve upon them, the punishment is very severely felt, and looked upon, even by the humblest peasant, with the greatest dread. Imprisonment is regarded by the great bulk of the population as light compared with the sentence of dishonour; and the prevalence of such a high tone of feeling regarding a check to crime, which in other countries is altogether ineffectual, is a phenomenon in social polity highly to the credit of the Norwegians.

Church. The Norwegian church is in principle and doctrine Lutheran, and remains as it was originally moulded after the subversion of the ancient faith, unaltered by the spirit of innovation, and unviolated by the hand of power. It is essentially ceremonial, almost as much so as the Roman Catholic. The altar is decorated with crosses and images, and the priest, arrayed in embroidered robes of velvet, celebrates high mass under that name. To maintain the ceremonial with decent splendour, as well as to support the clergyman in a respectable manner, it is necessary that the parishes should be of considerable size. There are in Norway 336 prestigilds or parishes; and many of these are exceedingly large, extending in some parts from the sea-coast to the Swedish frontier, and containing from 5000 to 10,000 inhabitants. This is certainly a low provision for religious instruction; but the people, generally speaking, are scattered all over the country, not clustered in towns and villages; and although individually they are not affluent, they are at least respectable, notwithstanding that as a whole they are poor. Under such circumstances, parishes must necessarily be large. There are five bishoprics in Norway, each of which has in it a suitable number of inferior clergymen. The patronage is in the hands of the five bishops and the Norwegian council of state, a committee of which has charge of all the affairs of the church. By judicious arrangements the abuse of patronage is prevented. Amongst the regular clergy there is one who has the superintendence over the concerns of four or five of the adjoining parishes; and the state of the church-property buildings, and the manner in which clerical duties are discharged, come under his cognizance. He communicates with the bishop of the diocese, and has a small allowance for performing these services, as dean or probst. This appears to be the only dignity in the church, with the exception of that of bishop. The incomes of the clergy are derived from tithes, commuted into a payment of grain, glebe farms, one of which the widow has for her life, offerings, and dues. These incomes in country parishes vary from 800 to 1600 dollars; but in large towns, or thickly settled parishes, they are higher. The bishops, says Mr Laing, have about four thousand dollars each. In proportion to the other professional classes in the country, the clergy are well paid, and the church has always been the first profession to which talent is naturally directed. The clergy are laborious and zealous in the discharge of their duty, the church service forming the smallest part of it. They have school examinations, Sunday schools, and other institutions for the promulgation of Christian knowledge. Mr Laing's impression is, that the Norwegian clergy are a highly educated body of men, being all acquainted with the literature of Europe, and some of them celebrated for their classical attainments. It is a peculiar characteristic of the Norwegian church, that there is no dissent from it; there are no sectarians in the country. This arises partly from the church having no temporal power, no political existence as a part of the state, no interests jarring with those of the other members of the community. In political rights and privileges the clergy are on a footing with the rest of the inhabitants, and are represented in the Storthing, like other citizens. The Lutheran religion is part of the state, but not the ministers who teach it. One chief cause of the influence of the ministers of religion, and the absence of dissent, is the high consideration in which the right of confirmation is held. The person who has passed this ordeal is regarded as having received a moral as well as a religious diploma, which capacitates him for an office of trust and responsibility. In connection with religion, we may mention the singular fact, that Bibles are remarkably scarce. Mr Laing could not obtain a copy of the Old or New Testament from the only bookseller in Drontheim, which contains 12,000 inhabitants, nor from the book-dealers at the fair of Levangor. The reason assigned for this remarkable deficiency in the sacred writings in a country attentive to religion, and sufficiently supplied with the catechism and the book of common prayer as used in the Norwegian church, is, that the Bible Society of London at one time sent over a great supply, and drove the regular dealers from the market by underselling them. In consequence of this they are now afraid to speculate in such a precarious stock.

Education is very generally diffused; but the standard of excellence is rather low, reading and writing constituting nearly the whole. It is provided for in the country parishes by an arrangement similar to that of Scotland. There are parochial schoolmasters, of whom some have fixed residences, and others live for one half of the year in one place, and for the other half in another. A small tax is levied from each householder, and every adult pays a small personal fee. There is a considerable degree of intelligence evinced in some of these communities; but the schools are too widely scattered over a thinly peopled country to be equally beneficial to all. It may be mentioned, that the clergy pay particular attention to the diffusion of education. The higher department of university education at Christiania is exceedingly expensive; and, besides, there is not such a demand for educated men in the medical, legal, and commercial professions, as in more densely-peopled and commercial countries, the tendency of which undoubtedly is to raise the standard of intellectual proficiency amongst all classes of the community. Those belonging to the learned professions are not numerous, because the demand is not great, and the supply is adjusted accordingly. The restrictions on the free exercise of trade and industry also operate with great force in depressing general education. Before a person can enter upon any medical or legal employment, before he can manufacture, buy, or sell as a merchant, he must obtain peculiar privileges from a corporate body. "As the expense of preparation," says Mr Laing, "and the small number of prizes to be obtained, place the higher and learned professions out of the reach of the main body of the people, as objects of rational ambition, for which they might endeavour to bestow superior education upon their children, so the restrictions and monopoly system shut them out from various paths and employments for which ingenuity, with ordinary useful education, might qualify them." With such a legislature as Norway possesses, it is to be hoped that these fetters upon the industry and intelligence of the country will not be allowed to remain much longer unremoved.

The press.

From the general diffusion of periodical publications, Mr Laing is led to infer that the Norwegians are a reading people. What is of great importance to the community is, that the press is by law perfectly free. There is no duty on newspapers, of which upwards of twenty are published; seven or eight in Christiania alone, and all in extensive circulation. Every little town has its local newspaper; and from the importance attached to local subjects there discussed, the bulk of the community are the purchasers, not the educated few. In type and paper they are superior to the French or German papers, and much ability is shown in conducting them. "Such newspapers as the American people read," says Mr Laing, "would not find readers in this country." There is no scurrility nor personal abuse displayed by those who write in them; yet the most entire freedom of discussion exists, public men and public measures being handled freely but decorously, and with a strict eye to the general good. There is no tax upon advertisements; and a measure to allow all periodical publications to be transmitted free of postage was lately negatived, only because the revenue of the post-office had been appropriated to certain specific purposes for the three years next ensuing. Some newspapers which are supposed to be particularly favourable to government are allowed by royal favour to pass free of postage at present, and no doubt is entertained that ere long all will be placed upon the same footing. A number of periodical and occasional works besides newspapers are published. There are two weekly magazines in great circulation; several monthly journals devoted to literature, antiquarian, agricultural, and military subjects; and in almost every newspaper there is the announcement of some new work or translation. Yet the literature which ought strictly to be considered as Norwegian is not yet of a very high order compared with that of other countries. But the mind of the country is advancing, and literature, which is young in Norway, will advance along with it.

Manners and customs.

The inhabitants of Norway are very polite in their manners, as well to each other as to strangers. They are partial to theatrical representations, so that the drama holds a high place in their estimation; and, besides the public theatres, there are societies of amateur performers in all the larger towns, and even in some of the villages. In music, dancing, and dress, the Norwegian females are by no means deficient. They have pleasing voices, and in every family of every station singing and dancing are constantly practised in the long winter evenings. Music is taught in the country by the organist attached to each parish. In the winter regular fairs are held, at which Swedes and Laplanders attend for disposing of goods. Christmas is kept in great style, and there are other festivals and various amusements which serve to relieve the tedium of winter and spring. The 17th of May, also, being the anniversary of their independence, is celebrated both at home and abroad by every Norwegian, and with marked propriety. Mr Laing gives a favourable account of the state of morals in Norway; but, without impugning so high an authority, if we are to take bastardy as a test, the statement is not borne out by the facts. The proportion of illegitimate to legitimate children is as one to five, which is as high as in London or Paris. But the evils entailed upon society by illegitimacy are partially alleviated by the state of the law in respect to this. Children are not only rendered legitimate by the subsequent marriage of the parents, as in Scotland, but the father, previously to his contracting a marriage with another party, may, by a particular act, legitimize them. The Norwegians are at all events a very hospitable, honest, industrious, and peaceable people.

Public improvements.

The government of Norway, aware of the value and importance of steam navigation, is making great and judicious exertions to promote it. This is a country where it is calculated to produce its greatest benefits, from the manner in which the peninsula is traversed by long arms of the sea, penetrating sometimes to its very centre. Steam-vessels are now seen plying on these fiords; they are commanded by naval officers; the fares are moderate; and in all that regards the comfort of passengers they rival our own. Roads and bridges are kept in a state of excellent order; a circumstance likely to happen in a country of proprietors, whose common interest it is to keep them in repair. There are no tolls in Norway; the principle of the farmers and others is to work in concert, and to keep up establishments for the common benefit.

The worst feature, perhaps the only thoroughly bad one, in the institutions of Norway, is, that the trade is not free. Each trade is monopolized by a sort of guild or fraternity, by which even country dealers are licensed. The pernicious effects of such a system we have sufficiently shown

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when treating of the fisheries; and we shall close our account of this interesting country with the following observations, extracted from a work of great authority on such subjects:

"The principle of equal partition of land among all the children, retained in Norway from the earliest period, prevailed also in England before the conquest. A relic of it remains in the law of gavelkind, still existing in Kent. The different effects produced on society by the retention of that law in the one country, and its general disuse in the other, are remarkable. In Norway, chiefly by its operation, a high standard of sufficiency has been preserved among the middle and labouring classes. Population has been prevented from increasing too rapidly by the fear which people have of falling below the general standard. There has, therefore, been a continual prevalence and diffusion of ease and well-being. But, on account of the absence of great inequalities of condition, and therefore of many of the usual stimulants to exertion, society has been kept at a low level. Great social freedom has indeed always existed, in consequence of the land being in the hands of the mass of the people; but there has been a want of ability, until a very recent period, to combine for the preservation of their political independence. During their earlier history, their political liberties were often variable and uncertain. After the union of their crown with that of Denmark in 1380, it appears that the Danish nobility gradually encroached upon their privileges; for when, in 1660, the crown and the people combined against the nobility, and abolished the states in Denmark, a similar revolution also took place in Norway; and that country continued under absolute government until the establishment of its constitution in 1814. Their udal laws trained them in the management of their own affairs, and produced that feeling of self-respect which the possession of property, and of land in particular, is calculated to give. These, together with the civil institutions preserved or introduced whilst they were under the Danish crown, prepared them for the large measure of freedom to which they have now attained. The evil of their udal system is its tendency to obstruct the development of intellect, and to keep society stationary. But since 1814 they have made great progress. Stimulants to mental activity are now no longer wanting. Their continual collision with Sweden, the problem of their internal restrictions on trade and commerce, the routine of their government, and the wholesome struggles always arising in a free state, will supply them. Their land will become more productive, by the application of science to its cultivation; their trade will also be expanded. If we open our ports to their timber, which we may one day see accomplished, their wealth will increase. And, according to the experience of the last twenty years, wealth will not materially disturb the peculiarities of their social system."[1]

R. R. R.

NORWICH, a city of England, the capital of the county of Norfolk. No historical notices of the place are to be found during the period of the Roman government in this island. Its origin was during the Saxon heptarchy, when, in 446, a castle was first erected, on an elevation surrounded by water and marshes, which having become drained by natural, aided by some artificial means, gradually served as the site of the present city; its progress was slow, till Uffa, one of the kings of the East Angles, built a more solid castle in 575; and, the habitations having increased, it became the capital of the kingdom of the East Angles, which then comprehended the counties of Suffolk, Norfolk, and Cambridge.

It was captured by the Danes about an hundred years afterwards, and during the two succeeding centuries was often lost and won by that people, till Alfred the Great, in 872, had subdued those erratic conquerors, when he greatly improved the fortifications of the castle, which, having been originally of earth, he rebuilt with brick. In the reign of Ethelred, the Danes, under their king Swayne, again seized upon Norwich in 1003; but being expelled by Ethelred the next year, the city was left in a most desolate condition till 1011, when Swayne again returned, captured the castle, rebuilt the fortifications of the town, and conferred the government of it on one of his commanders, named Turkel or Turketel, who seems to have maintained himself in that post many years, and, notwithstanding occasional hostilities between the Danes and the Angles, to have contributed greatly to the advancement of the place, which was then constituted a borough. After the final expulsion of the Danes, in the latter part of the tenth century, the town increased with rapidity; much of the marshy ground was drained and built upon; and the first churches of stone were erected, some of which exist at the present time. Norwich had been created an earldom by Edward the Confessor in 1049; and in the reign of William Rufus the episcopal see was removed from Thetford, in 1094, when it became a city, but only received a charter of incorporation in the reign of Henry I., in the year 1100. The chief officer was then denominated *præpositus* or provost; but in 1152, by another charter, extended still further in 1189, the title of mayor was given, and the right of the citizens to elect that officer was conferred upon them.

This city was the residence of several of our monarchs at some periods during the reigns of John, of Henry III., and of Edward I.; and the cathedral having been finished in the year 1278, the latter sovereign assisted at the solemn ceremony of its consecration.

In the year 1336 the foundation of manufactures was laid in Norwich by a colony of Dutch and Flemish weavers, who had been driven from their own country by a great inundation. The goods they made were from woollen yarn, the best spinning of which was executed first at the town of Worsted in this county, and by the name of which thread made of wool has ever since been distinguished. By this manufacture the city rapidly attained a degree of opulence before unknown, and the traces of which have continued to the present day.

King Henry III., with his Queen, Philippa, visited the city, when a grand tournament was exhibited; and they repeated their visit two years afterwards, when a new charter was granted, which extended the powers and privileges of the citizens. In 1348 the city was afflicted with that dreadful visitation known as the plague, from which, it is said, more than 57,000 persons were carried off in seven months. Before that calamity the city is said to have contained 70,000 inhabitants, having sixty-nine parish churches, and eight religious houses. But it must soon have recovered from this visitation, as it is related that, two years afterwards, a grand tournament was held, at which Edward the Black Prince was present, for whose entertainment the citizens provided a magnificent banquet, at the expense of thirty-seven pounds four shillings and sixpence.

In the year 1422 the doctrines of the reformation made their appearance in Norwich, and several persons were

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[1] Edinburgh Review, No. cxxxi. p. 60.

executed as Wickliffites, or, as they were then called, Lollards; and during the early part of the reign of Henry VII., between 1422 and 1448, many suffered severe whipping and other punishments, upon suspicion of entertaining the new opinions. These persecutions were continued at intervals till the reign of Edward VI., when, in the year 1538, the Protestant system being established by law, all the images in the cathedral and the parish churches were destroyed, and the different orders of friars and nuns in the religious houses were suppressed. On Trinity Sunday in that year the prior and monks in the cathedral changed their dresses for the habits of deans, prebends, and canons, and the Protestant worship was celebrated in it, and in all the parish churches within the city.

In 1549 this city was the theatre of a tumultuous insurrection, resembling that of the Jacquerie in France, and the peasants' war in Germany. It was at first an insurrection of the rural population, on complaints respecting the enclosure of common fields. As soon as numbers had been collected, they chose as their leaders two brothers of the name of Kett, one a tanner, the other a butcher; and on the 7th of July their numbers amounted to 16,000 men. They surrounded the city, and from thence increased their numbers to more than 20,000. Having established themselves near the city, the Ketts proclaimed themselves the king's deputies, and established a pretended court of judicature under a spreading tree, which they called the Oak of Reformation. Many gentlemen and clergymen were made prisoners by this rabble, and treated with the most barbarous cruelty. They made several attempts to force their way into the city, and succeeded in making some progress towards its reduction; but being repulsed, they, on their retreat, set fire to the houses in several places, so that some streets were consumed, and the whole city would probably have been rendered a heap of ruins, if an unusually heavy fall of rain had not checked the farther extension of the conflagration.

Whilst the insurgents still continued the siege, they were quarrelling amongst themselves, and committing the most atrocious acts of violence on the surrounding country, as well as on the persons of the gentry who were so unfortunate as to fall into their hands. They at length became masters of the city, though a small body of forces under the Marquis of Northampton had been sent to defend it. At length a more powerful body, commanded by the Earl of Warwick, made its appearance before Norwich. The first efforts of the royal troops were unsuccessful, and the rebels obtained possession of the artillery and ammunition of the Earl of Warwick, but were too ignorant of their use to improve the advantage they had gained. New troops were brought to the royal army, when a bloody attack, in which 3500 of the rebels were killed, decided the contest. A general pardon was proclaimed to all but the leaders, who were soon seized, and tried for rebellion; some were executed on the spot, but the Ketts were conveyed to London, and there convicted, but at length sent back to the place where their guilt had been incurred, and executed with great cruelty.

From the extinction of this rebellion, which, as before stated, commenced on the 7th of July, and was terminated on the 29th of August, the history of this city has nothing so peculiar as to make it an object of attention distinct from the general history of England.

Norwich is partly built upon a plain on the banks of the Wensum, a branch of the river Yare, which has been from time immemorial navigable for barges to its entrance into the sea at Yarmouth. Of late years a project has been executed for rendering this city accessible to vessels of considerable burden direct from the sea. This has been done by forming a canal ending in the lake, or, as it is provincially called, the Broad of Loathing, whence, by some excellently-constructed flood-gates, an opening into the sea at Lowestoff has been completed.

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The city, built on the very gentle acclivity of a hill, is distinguished by one peculiarly striking feature; a large sugar-loaf hill of considerable elevation, which (whether formed by nature or by art, has been frequently a subject of dispute) stands in its centre. On the summit of that hill, towards the south-west, stood the ancient castle, of very remote but doubtful origin, though tradition, as before stated, has ascribed it to a king of the East Angles, who reigned about the year 575. It long continued strongly fortified, and, till more peaceful times have made such objects of less importance, served as the means of either protecting or overawing the city. Great alterations have been made on the level at the top of the castle hill at various periods; and, finally, since the year 1793, it is occupied with a pile of buildings as nearly resembling the architecture of the old castle as could be adapted to the purposes for which it is now used. Though the outside has a heavy and indeed gloomy appearance, the interior is appropriated with great judgment and taste as a county jail, a county hall, and an apartment for holding general county meetings.

As this castle hill covers a large space, and as the streets either converge from or wind round it, those in the vicinity, which are the scenes of the greatest activity, are both narrow and crooked, and have rather a gloomy appearance. This is indeed in some measure relieved by an extensive market-place, a large open oblong square, said to be the finest in England. This market is most abundantly supplied with provisions of all kinds, and of the best description, on Wednesdays and Saturdays. The spots for the different articles are kept separated into those for meat, for fish, for vegetables, and for poultry, butter, eggs, &c. The houses which surround the market-place are lofty and elegant, many of them have been recently new-fronted, and some rebuilt, and most of them are occupied by well-embellished shops. In the front of these shops, what is called the Gentleman's Walk was the first part of the city paved with flag-stones, and was long the chief promenade in the city.

At the northern corner of the market stands the guildhall, an ancient and large building constructed of black flint, with cornices, window-frames, and battlements of Portland stone. The assizes for the city and the county of the city are held in an appropriate apartment of this edifice, as well as the elections of members of parliament and other elective functionaries. The upper part of the building is a room supported by fluted pillars of the Corinthian order, designed for the justices of the peace of the city, having the mayor's council-chamber within it, with a large and two small windows of beautiful stained glass. It is adorned with portraits of former distinguished members of the corporation, and more especially by a naval trophy presented by Lord Nelson, containing, in a glass case, the sword of the Spanish admiral, delivered up to that hero at the great victory gained near Cape St Vincent on the 14th of February 1797.

St Andrew's Hall, a public building, chiefly used for the social meetings of the corporation, or other public bodies, is an ancient foundation; but in its present state it is a regular and beautiful structure, consisting of a nave and two side aisles, more than fifty yards in length and thirty in breadth. It is adorned with some portraits of former magistrates by eminent artists, set in elegant frames, carved with great labour, and highly gilded. Under the gallery, at the west end, is suspended the ensign of the French ship Genereux, presented by Sir Edward Berry, the brave captain of the Foudroyant, in the year 1800. Amongst the paintings in the edifice is a fine full-length of Lord Nelson, and two historical pictures by Martin, a native of the city;

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one representing the story of Edward and Elenora, the other the execution of Lady Jane Grey. The Dutch congregation have the right of assembling here on Sunday for public worship.

The most prominent public edifices in this city are those for ecclesiastical purposes. The first of them is the cathedral, a venerable pile, one of the finest remains of Saxon architecture in this country. This building was originally erected under a Bishop Herbert, in the year 1069; and it has undergone various alterations and improvements at subsequent periods up to the present time. It is 400 feet in length, from the entrance door at the west to the east end. The west front is handsome and uniform; and the upper part is ornamented with four turrets of stone-work, and one large and two small doors. Over the centre door is a large Gothic window, extending the whole breadth and depth of the nave. The two transepts extend in length about 180 feet from north to south. The north front is ornamented with two pinnacles of stone, and over the middle door is a carved figure of Bishop Herbert, the founder. The south front has likewise two pinnacles of stone, between which, in the pediment of the roof, is a handsome dial. The interior, on entering the west front, exhibits a very pleasing appearance, arising from the uniformity and the neatness of the building, having a space of 204 feet to the entrance of the choir, which is fifty-four feet wide and seventy in height. The roof is of stone, supported by two rows of massive pillars, and is curiously arched, and carved full of small figures representing many passages of history from the Old and the New Testament. These figures are in a state of good preservation, although they have existed ever since the year 1463. The roofs of the north and south transepts also exhibit the same kind of curious workmanship. The whole of the roofs are highly esteemed by the curious, and it is said they are the only carvings of this kind that have existed so long, and been so perfectly preserved. The roof of the chancel is eighty-four feet high, and the arches and carved figures in it are very curious. The choir is spacious and beautiful; the stalls of the dean, of the vice-dean, archdeacons, prebendaries, and canons, as well as the bishop's throne and the chancellor's seat, are of Gothic carved work; and near them a temporary pulpit is placed for the weekly preacher. At the east end of the choir are four painted windows, the lowest representing the transfiguration, and the other some of the apostles, evangelists, and prophets. In the body of the cathedral are a number of monuments to the memory of distinguished ecclesiastics who have filled the different offices connected with this church. The tower rises in the centre of the building, at the meeting of the four roofs. The ceiling is there 100 feet in height, and the tower rises 140 feet above that. The outside is adorned with curious Gothic carved work, and is crowned with a battlement and four small spires. From the battlement a spire rises sixty-four feet, thus making the cross and weathercock at the apex 306 feet from the ground. From the low spot upon which it stands, it is not, however, a conspicuous object at a distance.

The cloisters adjoining to the cathedral excite much attention. It consists of the largest and most beautiful quadrangle in England, and was built in the year 1279. It is about 174 feet square, each of the four sides being twelve feet wide; the arches are Gothic, and the windows were once furnished with painted glass. The roof is full of historical figures, the subjects being taken from the gospel, the Revelations, and ecclesiastical history; and it is upwards of fifteen feet in height. At the south-west corner are two lavatories, ornamented with curiously carved work, representing the inveterate antipathy borne by the monks towards the secular clergy. The roofs contain no less than 418 historical figures.

The bishop's palace is a vast pile of building, very antique, but modernised in some degree at subsequent, and in the greatest degree in comparatively modern times. The principal entrance is through a large and ancient gateway, with an ornamented Gothic arch. The only object within deserving of notice is the chapel, a neat and spacious edifice of white stone, most neatly fitted up. The whole precinct of the cathedral is surrounded with a lofty stone wall, except on the eastern side, where it is bounded by the river.

The parish churches are more numerous here than in any other place in England, excepting the metropolis. Few of them deserve notice; some of them are small, and several of them but a few years ago were covered with thatch. The whole number is thirty-eight. One of the oldest, and by far the largest, is that of St Peter's Mancroft. It is a fine building, 180 feet in length and sixty feet in height, with north and south aisles each 120 feet long. The inside is much admired for the lightness of its construction, the slenderness of its pillars, and the number and size of its windows. It contains many, and some remarkably fine, monuments. In the tower is a ring of twelve musical bells put up by a voluntary subscription of the parishioners in 1775. They vary regularly in weight from six hundred-weights three quarters five pounds, to forty-one hundred-weights one quarter four pounds, weighing together nine tons four hundredweights twenty-four pounds. They are highly harmonious, and are commonly rung on festivals and holidays.

Besides these numerous churches, there are places of worship for two foreign congregations of Protestants, two Roman Catholic chapels, two Quakers' meeting-houses, and chapels for each grade of dissenters from the Socinians to the Huntingtonians.

The city is well supplied with benevolent institutions for the relief of distress. Bethel Hospital, for lunatics, is endowed; St Giles Hospital, an ancient establishment, provides for a hundred poor, equally divided between males and females; Doughty's Hospital, from the name of the founder, supports twenty-four aged men and eight women; the Girls' Hospital, united with the Boys' Hospital, and with an altered establishment, provides for a large number of both sexes, both in clothing and in maintenance; the Infirmary is supported chiefly by parochial assessments; the Asylum for Indigent Blind was opened in 1805, by the beneficence of an individual, and the aid of voluntary contributions; Cook's Hospital provides for ten aged females; and the Norwich Dispensary, founded in 1804, provides the poor with medicine and medical advice gratis. The voluntary associations for purposes of beneficence are the following, besides some of a private nature, viz. the Humane Society, for recovering persons apparently drowned; the Friendly Society, for the benefit of women in old age or sickness, administered by ladies, who distribute a large sum annually; the Friars' Society, which dispenses to the industrious poor the charity for clergymen's widows; the Benevolent Association, which has for its object the relief of decayed tradesmen; the Norfolk Benevolent Medical Society, and the Amicable Society of Attorneys, which relieve the distressed members and families of their respective professions; and the Society of Good-Will, which aids those who are not entitled to any parochial relief.

Amongst charities for educating the poor, the St George's Company, an old institution of the year 1700, must be noticed. It is chiefly supported by voluntary contributions, and educates some hundred boys and girls, who attend public worship in six parish churches. Almost every one of the various dissenting congregations has either Sunday or daily schools attached to their respective places of divine service.

One establishment, although supported by and extende to the whole county of Norfolk, is the County Hospital, witl out St Stephen's gate, erected in 1772, but enlarged at a subsequent period. A great number of patients are continually admitted and relieved by this excellent institution. The most eminent medical men attend daily, and the hospital is at all times open for accidental cases.

For objects of amusement, Norwich has an assembly-room, a neat building, erected in 1756; and a theatre, considered as one of the most complete in the kingdom out of London, in which a company perform a few months in every year.

The population of Norwich in 1801 amounted to 35,252, in 1811 to 35,338, in 1821 to 50,190, and in 1831 to 61,110. But there are portions of some of the parishes beyond the boundaries of the city, though forming part of the suburbs. Thus, in 1831, the parish of Hellesdon contained sixty-one inhabitants beyond the city boundaries, St James' had 1669, and Thorpe had 940; thus making the population at that period amount to 63,770. As the increase up to the present time has been as great as in the preceding ten years, the population at the present time, 1837, must exceed 70,000 persons.

Norwich has been the seat of manufacturing industry from a very early period, the commencement of which has been remarked in the historical notices of this article. The long disturbances in the Netherlands, and the persecutions under the Duke of Alva in particular, produced immigrations from thence in greater number, and much more important, than those which had preceded that period; and the immigrants received the greatest protection from the government of Queen Elizabeth. The goods fabricated by these people were chiefly of wool; but some were made from flax and from hemp. The woollens received appropriate names, the exact significations of which are now nearly lost. Soon afterwards a peculiar fabric was produced, from a mixture of silk or of mohair with the wool. This gave a great impulse to the trade, and produced a considerable demand for the great markets of Frankfort, Leipzig, and others in the north, and for Spain, Portugal, and Italy in the south. At the beginning of the eighteenth century, about the year 1720, this trade was at its zenith. Almost the whole female population of Norfolk and Suffolk was employed at the spinning wheel; and though 50,000 tons of wool were used, it was found necessary to draw supplies of yarn from other districts. The establishment of manufactures in Yorkshire, where coals, provisions, and labour were cheaper than in Norfolk, gave a heavy blow to the trade of the city; which would have been more severely felt, but for the fluctuations of fashion having created a greater demand for bombazines, an article which had been early made there, but had at first languished. The Yorkshire workmen, and the substitution of machinery for female hands, reduced the making of the ancient kinds of goods to a low point; and that was chiefly maintained by the East India Company purchasing annually a very large quantity of camblets for the China market. During the period from 1700 to 1800, the population of Norwich declined till towards the end of the century, when some new manufactures, and a great revival in the bombazine trade, gave an impulse, the effect of which has continued with increased force to the present day. The introduction of the shawl manufactory, one of the chief causes of the present prosperity, took place about the end of the last century; and the fabric has gradually improved till it has almost supplied the whole trade of the kingdom, besides furnishing much for foreign markets. Besides this trade, and the making of bombazines, there are some of silk goods produced, and smaller manufactures of cotton and hempen linen. The malting is a considerable trade; and the corn market, from the easy connection with London through Yarmouth or Lowestoff, is one of the most extensive in the kingdom. It appears by the official returns of 1831, that there were in the city 3752 males above twenty years of age employed in manufactures. According to the returns of the same year, the whole number of the families within the city was 15,572, of whom 9174 were chiefly employed in trade, manufactures, and handicraft; 509 in agriculture; and 4889 not comprised in either of the two preceding classes.

The relative extent of trade in different towns may be in some measure determined by the amount of the postage of letters collected in them. In this view, Norfolk stands the ninth in the list of English towns, being next after London, Liverpool, Manchester, Bristol, Birmingham, Leeds, Hull, and Sheffield; and the sum collected having amounted in the year 1836 to L.9557. 10s. 3d.

The corporation of Norwich, before the municipal reform law was enacted, consisted of a mayor, a recorder, two sheriffs, twenty-four aldermen, and sixty common-council men; but by that law, instead of four wards, as formerly, it is now divided into eight, and has sixteen aldermen and forty-eight common-council men, chosen by the inhabitants, and justices of the peace and a recorder nominated by the crown. This city, as before, returns two members to the House of Commons, chosen by a very numerous body of resident electors, comprising, besides the ten-pounds householders, many hundreds of freemen. The title of Earl of Norwich was conferred upon the Scotch Duke of Gordon; but that title, as well as the dukedom, is now extinct.

NOSE, the organ of smell. See ANATOMY. The uses of the nose are, exciting in us the sense of smelling, and serving in the great office of respiration, as well as in modelling the voice, receiving the abundant humours from the eyes, and adding to the beauty of the face. The nose was by the augurs particularly attended to in forming conjectures concerning future good or ill success. The tingling of the right or left nostril, for instance, was thought to indicate different things, as it happened to different sexes, or to persons in different conditions.

NOSOLOGY is a Greek word signifying a discourse or treatise of diseases, otherwise called *pathology*. The importance of a comprehensive and accurate nosology has been long and generally allowed. Baglivi, Boerhaave, Gorter, Gaubius, and Sydenham, have expressed their desire for a work of this kind, the great object of which should be to fix the pathognomonics of every disease, or to dispose all diseases into certain classes, orders, and genera, founded on distinctions taken from the symptoms only, without regard to remote or proximate causes.

NOSTOCH, SHOT STARS; *tremella nostoc* (Lin. *Spec. Plant.*; Dillenius, *de Muscis*, tab. 10, fig. 14; *Flor. Danica*, tab. 885, fig. 1); *tremella intestinalis vel mesenterica* (Lin. *Spec. Plant.*; Dillen. *de Mus.* tab. 10, fig. 16; *Flor. Danic.* tab. 885, fig. 2). The substance in question is not unfrequent in England, and in other parts of Europe, after rains, both in spring and autumn. Very large spots of it are seen in gravelly soils, and particularly on the tops of hills and on open downs, and it is often found on gravel walks. It is met with in some of the old authors, under the name of *nostoch*, as in Paracelsus and others; and the alchemists fancied there was something wonderful in it, and that it would afford a menstruum for gold. Nostoch is said to be a word synonymous with *Jaculum alicujus stellæ, vel potius ejus repurgatione dejectum quid in terram, flos aëris, fragmentum nimbi*; as this substance was believed to fall from the sky, along with the meteors which we often see, and call *falling-stars*. Hence the country people in Sweden have called it *sky-fall*; and in England it is known by the name of *witches' butter*, in common with some of the gelatinous liver-worts.

Paracelsus, Helmont, and others, however, ranked it with the *terniabin*, or manna, and thought it dropped, as the lat-

Nostradamus.

ter did, from heaven. It is described, and the chemical analysis of it given, by M. Geoffroy, in the Memoirs of the Academy of Sciences for 1708, and is there said to yield, besides an acid phlegm, a portion of concrete volatile salt and some fixed salt. The distilled water from it was believed by some to possess singular virtues in allaying pains of the joints; but there is certainly no ground for attributing to it any extraordinary qualities. Since the days of Paracelsus it has been considered as a vegetable production; but the botanists have had difficulty in assigning to it its place or genus in their several systems.

Naturalists had, however, for some years begun to doubt whether the substance in question was of a vegetable or animal nature, when at length the latter opinion received a strong corroboration from the observations of Mr Platt of Oxford, in a letter printed in the Gentleman's Magazine for 1776.

"From a child," says he, "I remember seeing the meteors shooting in the air, which appearance, by my comrades, was called *star-shooting*, believing the stars no larger than their apparent magnitude. This jelly-like substance, mentioned in your magazine, was believed to be the dross of these meteors, and took the name of *star-shot*, which passed for certain with me till I had arrived at the age of twenty-four, when I was engaged in business that required my frequently passing over both meadows and pasture-grounds, where in spring and autumn I saw many portions of this supposed alga or nostoch, but never more than one or two contiguous, mostly near the water, when the meadows were or had been just before flooded. My conjectures were various, until I saw a crow pecking of something in a field, which I heard to cry; when turning my horse to the place, I found a frog of the common size, which the crow (of the carrion kind) would soon have killed and gorged, had I not disturbed her, and chased her away.

"About this time I found in a meadow the bowels of a frog indigested, and compact as the chitterlings of a calf or pig, but white as the paper I write upon, though not translucid. I took it up and placed it in a paper exposed to the air, leaving it in some grass where I found it, till my return that way in three days' time, when I saw it changed to that tremulous jelly-like substance, the alga or star-shot. I was much pleased with this discovery, and took it home in my pocket wrapped in a paper, where I showed it to a society of young persons of which I was a member, who agreed with my sentiments of its being the indigestible part of a frog disgorged by some bird of prey.

"To corroborate my sentiments of this alga being the bowels of a frog, I luckily saw some of it lying by the side of a brook, where I lighted and took it up, and to my great surprise found attached to the jelly the head, heart, liver, and one leg of the frog, which had been, I presume, disgorged by some carrion crow, who frequented the flooded grounds to pick up worms and other vermine. There was also some of it found on an apple-tree at Wyston Magna, near Leicester, where I then lived, which, no doubt, was disgorged by some owl."

Dr Darwin, in his Poem on the Loves of the Plants, is of the same opinion with Mr Platt, that these gelatinous substances are of an animal nature; and that the different appearances they put on are owing to various circumstances, viz. the different birds who feed on frogs, the quantity they devour at a time, and the state of digestion before they are voided.

NOSTRADAMUS, Michael, an able physician and a celebrated astrologer, was descended of a noble Provençal family, and born on the 14th of December 1503, at St Remy, in the diocese of Avignon. By his grandfather he was initiated in the study of the mathematics, and he afterwards completed his courses of humanity and philosophy at the college of Avignon. Having repaired to Montpellier, he there applied himself to physic, till being forced away by the plague in 1525, he took his route towards Toulouse, and passed on till he reached Bordeaux. This course occupied him five years, during which he undertook the cure of all such patients as were willing to put themselves under his care. After this he returned to Montpellier, and, having been created doctor of his faculty in 1529, revisited the places where he had before practised physic. At Agen he contracted an acquaintance with Julius Cæsar Scaliger, which induced him to make some stay in that town, where he married; but having buried his wife, and two children which she had brought him, he quitted Agen after a residence of about four years. On his return to Provence, he established himself first at Marseilles; but his friends having provided an advantageous match for him at Salon, he, in 1544, transported himself thither. In 1546, Aix being afflicted with the plague, he went thither at the solicitation of the inhabitants, and proved of great service; so that the town gave him a considerable pension for several years after the contagion ceased. Returning afterwards to Salon, he became a recluse, and employed his leisure in applying to his studies. He had for a long time occasionally followed the trade of a conjurer, and now he began to think himself inspired, nay, miraculously illuminated with a prospect into futurity. As fast as these illuminations had discovered to him any future event, he entered it in writing, in enigmatical prose sentences; but revising them afterwards, he thought the sentences would appear more respectable, and would savour more of a prophetic spirit, if they were expressed in verse. This opinion determined him to throw them all into quatrains, and he afterwards ranged them into *Centuries*. When this was done, he hesitated about making them public, till reflecting that the time of many events which he had foretold was very near at hand, he determined to print them. This he did with a dedication addressed to his son Cæsar, an infant only some months old, in the form of a letter or preface, dated the 1st of March 1555. This edition, which includes seven *Centuries*, was printed by Rigault at Lyons. He prefixed his name in Latin, but gave to his son Cæsar the name as it is pronounced, *Nôtradame*.

The public were divided in their sentiments respecting this work. Many looked upon the author as a simple visionary or a fool; whilst by others he was accused of the black art, or magic, and treated as an impious person, who held a commerce with the devil. But there were not wanting persons who believed him to be really and truly endowed with the supernatural gift of prophecy. A few remained in suspense, and refrained from giving any judgment at all respecting his pretensions. But Henry II. and Catherine of Medicis his mother, having resolved to see the prophet, he received orders to that effect, and immediately repaired to Paris. He was very graciously received at court, treated with extraordinary respect, and gratified with a present of two hundred crowns. He was afterwards sent to Blois to visit his majesty's children there, and report what he should be able to discover concerning their destinies. No doubt he exerted himself to the utmost on this occasion, but the precise nature of his prognostications is not known; it is certain, however, that he returned to Salon loaded with honours and presents. Animated with his success, he augmented his work from three hundred quatrains to a complete milliad, and published it in 1558, with a dedication to the king. But that prince having died the next year, of a wound which he received at a tournament, the book of the prophet was immediately consulted; and in the 35th quatrain of the first century this unfortunate event was found predicted in the following verse:

Le lion jeune le vieux surmontera,
En champ bellique par singulier duel,
Dans cage d'or les yeux lui crevera,
Deux classes une puis mourir, mort cruelle.

So remarkable a prediction added new wings to his fame, and he was shortly afterwards honoured with a visit from Emanuel duke of Savoy, and the Princess Margaret of France his consort. From this time Nostradamus found himself overburdened with visitors, and his fame daily increased. Charles IX. on visiting Salon, was eager to see him. Nostradamus, who then waited as one of the retinue of the magistrates, being instantly presented to his majesty, complained of the little esteem his countrymen had for him; upon which the monarch publicly declared, that he should hold the enemies of Nostradamus as his own, and further desired to see his children. Nor did that prince's favour stop here. Not long afterwards, in passing through the city of Arles, he sent for Nostradamus, and presented him with a purse of two hundred crowns, together with a brevet, constituting him his physician in ordinary, with the same appointments as the rest. But the prophet enjoyed these honours only for the space of sixteen months, having died at Salon on the 2d of July 1566. Besides his Centuries, we have the following compositions of Nostradamus: A treatise *de Fardemens et de Senteurs*, 1552; a Book of singular Receipts, *pour Entretenir la Santé du Corps*, 1556; a piece *des Confitures*, 1557; and a French Translation of the Latin of Galen's Paraphrase, exhorting Menedolas to apply himself to study, especially to that of physic, 1552. Some years before his death, he published a small instruction for husbandmen, showing the best seasons for their several labours, which he entitled The Almanac of Nostradamus. Lastly, after his death there came out the eleventh and twelfth Centuries of his Quatrains. It is to these productions that the following pungent distich was applied:

Nostra damus cum falsa damus, nam fallere nostrum est,
Et cum falsa damus, nil nisi Nostra damus.

NOTÆ, signs used in writing, which have the force of many letters. This contrivance for expedition is of great antiquity. It was known to the Greeks, and from them passed to the Romans. By whom the invention was brought to Rome has not been precisely ascertained; but the most general opinion is, that in matters of importance Tully first made use of notes or short-hand writing when Cato delivered an oration in opposition to Julius Cæsar relative to the conspiracy of Catiline. Cicero, who was at that time consul, placed *notarii*, or expert short-hand writers, in different parts of the senate-house, to take down the speech; and this was the first public occasion which we find recorded of employing short-hand writers amongst the Romans. It is unnecessary to observe, that the name of *notary*, still in use, was derived from this practice. There were three kinds of notes for short-hand writing used by the ancients, either for despatch or secrecy. The first and most ancient was that of hieroglyphics, which are rather images or representations of things than of words. The second species were called *singulariæ*, from their expressing words by single letters. Sertorius Ursatus has compiled a very copious collection of such abbreviations. The third kind were called *notæ Tironianæ*, from Tiro the freedman of Cicero, who was particularly skilled in his art; and it is to him that we are indebted for the preservation of Cicero's letters, of which a great part still remain, one entire book having been addressed to Tiro himself.

It appears that notes were in frequent use amongst the Romans, and continued to be employed till the tenth and eleventh centuries. We have indeed but few books remaining which are written in short-hand; but this is not surprising, when such was the unhappy situation of early times, that either superstition condemned them to the flames as the works of impious magicians, or they were left, through ignorance and stupidity, to be devoured by vermin. It is probable, however, that there are still extant writings of this sort, which might contribute to enrich the republic of letters.

There are several manuscripts and instruments written in these kinds of *notæ* in the royal library of Paris. In the year 1747, the learned and ingenious M. Charpentier engraved and published at Paris a capitulary, and fifty-four charters of Louis the Pious, emperor and king of France, written in the *notæ Tironianæ*. To this work the learned editor has prefixed an *Alphabetum Tironianum*, together with a great number and variety of notes or marks for the different parts of speech, and rules for acquiring the art of writing in this kind of notes. Valerius Probus, in his book *De Litteris Antiquis*, explains many of the characters used by the short-hand writers; and there is a dictionary of them published by Gruterus.

NOTARII, persons employed by the Romans to take, by means of *notæ*, trials and pleadings in their courts of judicature, or to write as amanuenses from the mouth of an author. These *notarii* were of servile condition. Under the reign of Justinian they were formed into a college or corporate body. *Notarii* were also appointed to attend the prefects, in order to transcribe for them. There were likewise *notarii domestici*, who were employed in keeping the accounts of the Roman nobility; and when the empire became Christian, there were notaries for ecclesiastical affairs, who attested the acts of archbishops, bishops, and other spiritual dignitaries. We find ecclesiastical notaries at Rome under Pope Julius IV. and also in the church of Antioch about the year 370. From these notaries was derived the office of chancellor to the bishops; and afterwards almost every advocate was admitted a notary.

NOTARY (Notarius) signifies a person who takes notes, or frames short draughts of contracts, obligations, charter-parties, or such other writings. At present we call him a *notary public*, because he publicly attests deeds or writings, in order to make them authentic.

NOTATION, in *Arithmetic* and *Algebra*, the method of expressing numbers or quantities by signs or characters appropriated for that purpose. See Arithmetic and Algebra.

NOTES, in music, characters which are used, in writing or printing, to mark the pitch and the duration of the sounds of any musical composition. These characters or signs of notation have varied much at different times. Many alterations of those now generally received have been proposed, but not adopted. *Numerical* and *literal* methods of expressing musical sounds have been repeatedly proposed; but it seems that these are even more complicated than the signs in common use. A musical short-hand, constructed of alphabetical letters, was proposed many years ago in France, but rejected; although in numerous cases of simple melody and harmony it might be very useful in saving space to publishers of books. As to the notation of music in ancient and modern times, see Padre Martini, Hawkins, and Burney, and especially Mersenne regarding the *entablature* of some musical instruments now disused. See Music.

Note is likewise used to signify a mark made in a book or writing, where there occurs something remarkable and worthy of particular notice; as also an observation or explication of some passage in an author, added in the margin, at the bottom of the page, or elsewhere. In this sense it stands contradistinguished to *text*.

Note is also a minute, or short writing, containing some article of business. In this sense we say, promissory note, note of hand, bank-note, and the like.

NOTHUS signifies *spurious* or *bastard*; and hence it is

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figuratively applied by physicians to diseases which, though in respect of a similitude of symptoms they have the same denomination as some others, yet are of a different origin from them.

NOTION, a word which in common language is considered as of the same import with idea. See METAPHYSICS.

NOTITIA, in literary history, a book which gives an account of a particular country, city, or other place. Such are the *Notitia Imperii Romani*, the *Notitia Romæ Antiquæ*, and other similar works.

NOTO, a city of the island of Sicily, in the kingdom of Naples, the capital of the province of the same name, 149 miles from Palermo. It stands on a rocky hill, in a fine but unhealthy situation. It has elegant streets, with noble churches and convents, and forms one of the most respectable places on the island; whilst the surrounding soil, though much of it is neglected, is of abundant fertility. Its port is Avola, about seven miles distant. It contains 1958 houses, and 13,300 inhabitants.

NOTO, *Val di*, one of the three valleys or provinces into which Sicily is divided, and which lies between the sea, the Val di Demona, and the Val di Mazara. Noto is the capital town.

NOTTINGHAM, a large market-town of England, the capital of the county of the same name, in the centre of England. It is a place of great antiquity, deriving its name from the Saxon word *Snottingaham*, which is descriptive of its position as a retreat in rocks, since there were formerly many, and are still a few, caverns, cut on the soft rock on which its castle was built. It is by some antiquaries asserted that it was once a Roman station; but that is a subject of controversy. The earliest records notice some incursions of the Danes about 866; but they appear to have received a check from the town, and a defeat near it from King Alfred, who afterwards made it the winter-quarters of his army. William the Conqueror erected a castle, and constructed fortifications so strong as to render the place impregnable against any of the methods of attack which were then known. King Richard Cœur de Lion assembled a parliament in this place previously to his departure for the Holy Land, and another soon after his return from Palestine. It was from Nottingham that Richard III. marched forth to his fatal battle of Bosworth Field. There Charles I. erected his royal standard at the commencement of the civil war, at the spot which is now covered by St James' Church. The Castle of Nottingham, defended by the royalists, was besieged by the parliamentary forces under the command of Colonel Hutchinson, to whom, after a brave defence, it at length surrendered, the particulars of which are related in a most interesting manner by the wife of that officer. When Cromwell had attained supreme power, he ordered the fortifications to be destroyed and the castle to be dismantled. At the beginning of the present century, this town and neighbourhood were distinguished by the riotous disposition manifested amongst the lower orders, who acquired the denomination of Luddites, and were excited to destroy much of that machinery by the aid of which the town subsequently attained to its present high degree of affluence. These disturbances were quelled by the power of the law, and some wholesome severities; but it caused the removal of many of the capitalists, and a large portion of the trade, to distant and more tranquil districts. During the excitement respecting parliamentary reform in 1832, a very violent spirit was manifested, which led to the destruction of a silk-mill in the neighbourhood, the burning of the ancient castle belonging to the Duke of Newcastle, and outrages upon private houses. These disturbances led to a few exemplary punishments, and some heavy burdens on the town, to indemnify those whose property had suffered by the riots.

Nottingham is finely situated upon the side of a hill overlooking the valley of the Trent, and near to the south-western extremity of what was formerly the forest of Sherwood, once famous as the resort of the celebrated Robin Hood, but now a well-cultivated district. The environs of the town are picturesque and beautiful; and there is a delightful walk on the bank of the river Leen, having a fine view of the south front of the castle, and of the gardens, which were formerly the fish-ponds belonging to that edifice. The windings of the river Trent have also a great effect on the whole scenery.

Some of the old streets are narrow, but in the great extension of the place of late years some new and spacious avenues have been built, and much improvement has been judiciously effected. The market-place is one of the finest in England. It is spacious, occupying an area of 27,515 square yards, or rather more than five acres and a half. It is well paved, and admirably adapted for the purpose of the three weekly markets held in it on Wednesday, Friday, and Saturday, the last of which is the principal one. At the east of the market-place stands the Exchange Hall, which is a noble-looking building. The pediment is crowned with a well-proportioned pedestal, on which stands the figure of Justice. On the pediment are the town arms, with an oak branch on one side, and an olive branch on the other; and underneath it, with a clock intervening, is a handsome Venetian window, ornamented with two elegant Ionic columns, which lights the spacious room within it. That apartment, when the temporary doors which divide it are thrown open, is 123 feet long, thirty wide, and thirty high, with an arched ceiling. It is used for public dinners, at which more than 400 persons can be commodiously seated, and also for public meetings. This room was nearly destroyed by an accidental fire in 1836, but has been restored and further beautified. One part of the building is appropriated to magisterial business, and another is occupied by the Artisan's Library; an institution possessing some thousand volumes, which are lent out to members, who pay seven shillings and sixpence on admission, and one shilling and sixpence quarterly. Underneath the Exchange there are a few shops in front, but the principal part of the ground-floor is appropriated to shambles. In another part of the market-place is the Subscription Library, containing a large collection of valuable books; and a news-room; a cabinet of mineralogy, with sculpture, maps, and portraits of eminent individuals connected with the town, amongst whom are Colonel Hutchinson, Lord Byron, Sir Richard Arkwright, and others.

The other civic buildings are the county jail and hall, a commodious but not elegant structure; the house of correction, which stands on the site of a convent of the hospitallers of St John of Jerusalem; the town hall and town jail, where the borough assizes and sessions, and the mayor's and sheriff's courts, are held; the assembly-room, a very elegant building, just erected and fitted up with much taste; and the free grammar school, in which about a hundred boys are gratuitously instructed in Greek and Latin.

The edifices for religious worship are in about the same proportion to the number of the inhabitants as is seen in other places which have increased with similar rapidity. St Mary's is usually denominated the mother church of the town, from its priority of erection. It resembles a cathedral more than a parish church in its extent, its architecture, and its decorations, and is the most striking object in the place, when viewed from what is called the high pavement. It stands on an elevated spot, and is said to be nearly seventy feet above the level of the meadows near the town. The date of the erection is unknown, but is said to have been in the fifteenth century. It is in the form of a cross, and has a handsome square tower, in which there is a musical peal of ten bells. The length of the structure in the inside is 216 feet, the breadth in the centre ninety-seven, at the west end or principal entrance sixty-seven, and in the chancel twenty-nine feet. The height of the tower is 126 feet, and that of the side aisles sixty feet. The porch on the south side is a very ancient piece of workmanship, on the fluting of the pediment of which were sculptured red and white roses, some traces of which may even yet be discovered. In the west gallery there is an excellent organ of great power, supported by two Tuscan columns, over which is a picture of David playing on his harp. There are in this church many monumental inscriptions on tombs of the family of the Earls of Clare, and one of an Earl of Meath, and the mausoleum of the family of the Wrights.

Besides the mother church, there are provided for the adherents of the established worship the following edifices, all of them capacious, and appropriately finished, viz. St James', St Nicholas', St Paul's, and St Peter's. The chapels of various sects are numerous, amounting to twenty, but some of them are very small. They are classed thus: Independents; Baptists, two subdivisions; Wesleyan Methodists, three subdivisions; and one each for Unitarians, Roman Catholics, Quakers, Huntingtonians, and Inghamites or Sabellians.

The charitable institutions depending on endowed foundations or on voluntary contributions are numerous. The General Hospital, built in 1781, contains about two acres of land, given partly by the Duke of Newcastle, and partly by the corporation. It is supported chiefly by subscriptions, and usually contains about 120 patients; whilst between five and six hundred are out-patients, receiving medical advice and assistance. The General Lunatic Asylum is a modern and spacious brick building, erected in 1810, at an expense of nearly L.20,000. There are extensive courts, gardens, and places for recreation, and the whole economy of the place is constructed in such a manner as may best contribute to the recovery or the welfare of the miserable inhabitants. Labray's and Lambley's Hospitals are small asylums for aged widows; and Collins' Hospital is a splendid charity, founded by one of the Smith family of the town, of which Lord Carrington is the present head. It consists of twenty-four small but convenient dwellings for as many poor widows, each of whom receives four shillings weekly, and two tons and a half of coal every year. From the same endowment Carrington Street Hospital has lately been built, where twenty poor persons are comfortably accommodated. Plumtree Hospital, founded by a family of that name, since transplanted into Kent, in the year 1392, but twice repaired since, viz. in 1650 and 1751, has been rebuilt under an act of parliament passed in 1823. Thirteen aged widows are provided with comfortable dwellings within the house, and allowed six shillings weekly, whilst thirty others, called out-pensioners, receive ten pounds a year. Willoughby's Hospital contains nineteen tenements, the inhabitants of which receive a small pension. Wooley's Alms are dwellings for six poor persons; and Bilby's Almshouses for eight persons, who have each a loaf weekly, and two tons of coal at Christmas. Warser's Gate Hospital gives apartments to six, and Hanley's to twelve poor persons.

The other public edifices that deserve notice are the Barracks, built in 1792, a handsome building, with well-contrived apartments for officers and for the privates, and suitable stabling for three troops of horse; the Riding School; a small theatre, never long opened nor much attended; the water-works, in two parts of the town; the gas-works; and the bridge over the river Trent after that stream has been augmented by the waters of the Dove and the Derwent.

The population of this town in 1801 amounted to 28,861, in 1811 to 34,253, in 1821 to 40,415, and in 1831 to 50,680. This great increase, arising from the progressive extension of its manufacturing industry, is not, however, confined within the limits of the town, but is exhibited in the villages either contiguous to it and forming its suburbs, or at a few miles distance. Thus Snenton, which conjoins the town, contained in 1801 but 558, and in 1831 it had 3605 inhabitants; Radford, a parish within a mile of Nottingham, had in 1801 but 2269, and in 1831, 9806 persons; Lenton, another parish, in 1801 had 893 inhabitants, and in 1831, 3077. There are other parishes near to it, in which a similar progress has been making, so that Nottingham, with its dependencies, may be estimated, supposing that the increase since 1831 has been at the same rate as in the previous periods, to have more than 70,000 individuals. According to the account of Mr Rickman, the males above twenty years of age employed in the stocking and lace trade are, in Nottingham 4740, in Radford 1300, in Lenton 300, at Snenton 430, and at Beeston 300.

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The Trent, which is navigable up to the town, and the various canals which branch from that river, afford the means of easy communication with every part of the kingdom.

The chief accumulation of capital in the town and its vicinity has been from its manufactures. The most ancient, and still the most extensive, is that of stockings. The earliest introduction of that neat piece of machinery, the stocking-frame, at nearly the same period into Leicester and Nottingham, gave to those towns a superiority in fabrication, which has subsequently been maintained, and which has nearly superseded the domestic manufacture of knitting stockings. The stockings of the two towns, made either from wool, thread, cotton, or silk, are to be seen in every part of the world, and far excel in beauty and cheapness any that are made elsewhere in imitation of them.

The prosperity of Nottingham has, however, been advanced in a prodigious degree by a new manufacture executed by machinery, analogous to that of the stocking-frame, but contrived with a greater portion of mechanical ingenuity. This article of commerce is known by the name of bobbin net. It generally resembles lace, and has in a great degree supplanted that pillow lace for which Flanders, France, and some counties of England were once highly celebrated.

Although this trade originated at Nottingham, yet the riotous disposition of the workmen called Luddites (which has been already noticed), who opposed all those improvements in machinery to which the extension of this trade has been indebted, caused many of the capitalists to remove their establishments to other and some very distant counties. Yet, notwithstanding such removals, and the rivals thereby created, the trade here has gone on increasing, and is still most extensive in and around Nottingham. Our limits do not admit of tracing the various steps of improvement with great minuteness. At first, only plain nets were made, then quillings were introduced, and afterwards figured or fancy patterns were produced. The two last are the highest priced, and the chief object of the manufacturers here. The number and description of the machines in January 1836 were thus dispersed:—In Nottinghamshire, 372 for plain nets, 1006 for quillings, and 784 for fancies; in Leicestershire 207 for plain, thirty-seven for quillings, ninety-nine for fancies; in Derbyshire 192 for plain, forty-nine for quilling, fourteen for fancies; in Devonshire, Somersetshire, and the Isle of Wight, 654 for plain, thirty for quilling, 103 for fancies. Total for plain 1425, for quillings 1122, for fancies 1000. The improvement made by the introduction of the quilling and fancy nets has caused additional capital to be invested in machinery, and the employment of from 1500 to 2000 additional

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workmen; and the above statement shows that this benefit has principally fallen to the share of Nottingham.

The following calculation, made by Mr W. Felkin, will show, in a national point of view, the great value of this apparently minute branch of industry. That gentleman estimates that, in the year 1835, there were used in this trade 1.850,000 lbs. of sea-island cotton wool, valued at L.185,000, and 25,000 lbs. of silk, valued at L.40,000. The produce of these raw materials, and their disposal, are stated by the same person thus: Home consumption for nets, L.320,000; for quillings, L.210,000; for fancies, L.580,000; total, L.1,110,000. Foreign trade, for nets, L.340,000; for quillings, 282,000; for fancies, L.480,000; total, L.1,102,000.

The plain nets made in the other parts of the kingdom are mostly sent to Nottingham in the rough state, where they receive the finishing operations of gassing, bleaching, and dressing. The amount of these was, in the year 1835, L.328,000; so that this town, besides the profit upon the goods manufactured in and near it, gains a considerable share of the profit upon the goods made by their rivals.

The net wages earned by men vary from twelve to thirty-five shillings a week, according to the kind, the width, and the speed of the machines at which they are employed. Sixteen shillings is about the average. Wages to women vary from three to twelve shillings, as they may be occupied, but average about six shillings a week. Children are paid from one to four shillings, and can be useful as embroiderers, or in mending and winding. Mr Felkin says it is difficult to estimate how many persons altogether are employed in the various departments of this flourishing trade.

Besides the staple trades, there are, in and around the town, several large factories for spinning and weaving cotton goods.

Nottingham has been celebrated for its ale, the qualities of which have been the theme of song. It is still good, and very potent. Its excellence has been attributed by some to the good quality of the barley grown in the neighbourhood, by others to the purity of the water, and by many to the excellent cellars scooped out of the rock with which most of the good houses are furnished.

This town returns two members to the House of Commons. The freemen, who were formerly the sole electors, are still numerous, but are exceeded in number by the ten-pound voters.

By the municipal corporation reform law passed in 1835, this town is to continue a corporation, is divided into seven wards, and has a mayor, fourteen aldermen, and forty-two councillors, with twelve justices of the peace appointed by the crown.

NOTTINGHAMSHIRE, an inland county of England, bounded on the north by Yorkshire and a part of Lincolnshire, on the east by Lincolnshire, on the south by Leicestershire, and on the west by Derbyshire. It is of an oval figure, with its narrowest end towards the north. Its greatest length is about fifty miles, and its greatest breadth twenty-seven. Its circumference is estimated at 140 miles. According to the statement of Mr Rickman, the extent is 837 square miles, or 535,680 acres.

The county is divided into six hundreds, or, as they are usually denominated, wapentakes; three of which are to the north and three to the south of the river Trent. It contains nine market-towns, and 207 parishes. The annual value of all the real property of the county, as taken in the year 1815, for the purposes of the property-tax, was found to be L.737,220. The number of inhabitants at each of the four decennial enumerations amounted, in 1801 to 140,350, in 1811 to 162,000, in 1821 to 186,873, and in 1831 to 225,400. The burials in the ten years from 1821 to 1831 appear to have been one in fifty-four of the inhabitants then living. The illegitimate births were one in twenty of the whole births.

The occupations of the inhabitants in 1831, according to the arranged returns of Mr Rickman, were as follow:

Occupiers of land employing labourers	2,643
Occupiers of land not employing labourers	2,414
Agricultural labourers	11,799
Employed in retail trades and handicraft	14,683
Capitalists, bankers, and professional men	2,093
Labourers not agricultural	5,628
Employed in manufactures and machinery	14,260
Other males under twenty years of age	56,582
Male servants of all ages	1,132
Female servants	7,886

The number of inhabited houses was 44,936, occupied by 47,117 families. Of these, 13,351 were employed chiefly in agriculture, 25,578 in trade, manufactures, and handicraft, and 8188 belonged to neither of the foregoing classes.

The towns and villages containing more than 1500 inhabitants, and the numbers in each, were, in 1831,

Nottingham	50,680	Lenton	3,077
Newark	9,557	Bulwell	2,611
Mansfield	9,426	Retford	2,491
Basford	6,325	Hucknal-Torkard	2,200
Worksop	5,566	Clareborough	2,106
Sutton Ashfield	4,805	Kirby Ashfield	2,032
Greasley	4,583	Carleton	1,784
Arnold	4,054	Bingham	1,738
Southwell	3,386	Stapelford	1,533

The face of the country is generally level, with moderate undulations; and its beauties are of a mild description, somewhat picturesque in the vicinity of Sherwood Forest, but displaying neither the striking features of the adjoining county of Derby on its western side, nor the flat insipidity of the plains of Lincolnshire on its eastern side. From its position between these two descriptions of country, and from its moderate elevation, it enjoys a milder climate than either, partaking neither of the raw air of the one nor the moist atmosphere of the other. The dryness of the climate is favourable to early vegetation, and is supposed to be the cause of the seed-time and harvest in Nottinghamshire commencing at the same period as in the more southern counties.

The soil of this county is very various. On the borders of Derbyshire there is a stripe of land with coal and limestone, partly in wood, but mostly under arable culture. Parallel to it is a broader tract, including Sherwood Forest, the soil of which is chiefly sandy and gravelly; but though naturally sterile, it has in some degree been brought into a productive state by the extensive cultivation of turnips, and the maintenance of considerable flocks of sheep. The tract which adjoins is a clayey soil, extending to the banks of the river Trent. It is chiefly arable land, but varied with woods and meadows, and highly productive of wheat, oats, beans, and, in some parts, of hops. The lands on the banks of the Trent are very fertile, being mostly devoted to pasture, on which many oxen are fattened; and some of the dairies are extensive. The arable land of this district is celebrated both for the quantity and the quality of the oats which it produces. The beautiful vale of Belvoir, in the south-easternmost part of the county, enjoys some of the best soils, both for pasture and arable husbandry, of any part of this island. The farms are in general small, and commonly held by tenants at will, the rents taken from whom are generally moderate; and a very great proportion of the land is free from the burden of the tithes. The spirit of agricultural improvement has not proceeded so far as in many other counties, though it has made considerable progress of late years. Neither the breeds of cows and sheep, nor the modes of cultivation, differ so much from those of the adjoining counties as to deserve any especial notice.

There are no mines except those of coal, which are exclusively confined to a narrow district bordering on Derbyshire; the coal is of good quality, very abundant, and, by means of internal navigation, diffused throughout the whole county. Excellent stone for building is raised in many parts, some of which has the peculiarly valuable quality of improving by exposure to the weather. Many parts of the county abound in veins of gypsum. In the parish of Gotham it is found in strata of the thickness of three feet. At Beaconhill, near Newark, there are large quarries of this substance. Although it has been much praised as a manure, the trials of it that have been made in its vicinity have not been attended with such beneficial results as to induce the continued use of it for that purpose.

The Forest of Sherwood, formerly celebrated as the scene of the exploits of Robin Hood, whose deeds amused our nursery days, is mostly an open heathy plain, bordered with recent plantations, and upon which the plough has made very extensive encroachments. The boundaries of the forest are extensive, it being twenty-five miles in length, and from seven to nine in breadth; but a great portion of it has become the property of private individuals, and is enclosed in farms and parks; in the latter of which is to be found the deer with which this forest was once most abundantly stocked. The trees of most ancient date are those now remaining on the estates of the Duke of Newcastle and Lord Manvers.

Nottinghamshire is, for its population, one of the greatest manufacturing counties. The frames for making hosiery were the discovery of a clergyman of this county named Lee, in the reign of Queen Elizabeth, who, finding but little encouragement in England, repaired to Paris, and commenced his work under the auspices of Henry IV. The murder of that monarch having deprived him of a patron, he died of chagrin in France, and the workmen returned home, when, after many fluctuations, the machinery was introduced into this county. The making of stockings, caps, pantaloon-pieces, and other similar articles, has long given employment to the great mass of the labouring population; and of late years the making of lace upon a similar principle has been introduced, and created additional employment. Although the riotous conduct of the workmen, under the denomination of Luddites, has driven some of the large capitalists to other parts of the kingdom, yet the hosiery business is by far the most important means of employment throughout the whole county. The spinning of cotton-yarn, from its natural connection with hosiery, has been introduced and very widely extended; and the establishments at Nottingham, at Mansfield, at Newark, at Southwell, and several other places, are upon an extensive scale. There are also several large manufactories for spinning worsted yarn. Malting and brewing are carried on to a considerable extent; and the beer of Nottingham and of Newark rivals that of Burton-upon-Trent. There are potteries at Sutton Ashfield; starch is made near Southwell; and sailcloth and candlewick at Retford.

The foreign trade of this county is mostly conducted by the mercantile houses of London and Liverpool; but some of the larger manufacturers export their own goods, both to the continent of Europe and to the more distant parts of the world.

The river Trent, the fourth in magnitude of the English streams, passes across the county, and is navigable for barges throughout the whole of it; but its deficiencies of water and its shoals are such great impediments that a canal by the side of it, ten miles in length, is found of great use to the intercourse. The other rivers are not navigable, but are beneficial for the purposes of irrigation. They are the Erwash, the Soar, the Maun, the Meden, the Wollen, the Worksop, the Idle, the Lene, and the Dover or Dare. These all discharge their waters into the Trent. The canals are, the Nottingham, the Grantham, the Idle, and the Chesterfield. The last of these is about forty miles in length; the others about ten each. By means of these and the Trent, the intercourse by internal navigation is extended to almost every district of the county.

The titles derived from this county are those of Marquis of Granby, Earl of Mansfield, Viscount Newark, and Barons Pierrepoint and Carrington. For election purposes, the county has been divided into two districts, the northern and the southern. Each of them returns two members. The election for the northern division is held at Mansfield, and the polling places are, that town, East Retford, and Nottingham. The election for the southern division is held at Newark, and the other polling places are Bingham and Southwell. The three boroughs, Nottingham, Newark, and Retford, return each two members, as before the passing of the reform bill. The whole of the county is in the diocese of York, and it is on the midland circuit of the judges.

The remains of Roman and Saxon antiquities are numerous. Amongst the former are the camps at Barton Hill, at Combes Farm, at Gringley, at Hexgrave, and at Wenny Hill, and a Roman villa near Mansfield. Amongst the latter are the Castle of Newark, the abbeys of Newstead, Rufford, and Welbeck; the priories of Mattersey and Worksop; and the churches of Bingham, Blythe, Southwell, and Balderton.

The most distinguished natives of this county have been, Archbishop Cranmer, Dr Erasmus Darwin, Sir Martin Frobisher, Denzil Lord Holles, Ireton the son-in-law of Cromwell, Lady Mary Wortley Montagu, Paul Sandby, Archbishop Secker, Gilbert Wakefield, and Bishop Warburton.

The seats of noblemen and gentlemen of the first class are as numerous as in any county of England. Of these, the most remarkable are the following, viz. Annesley Hall, J. W. Chaworth, Esq.; Babworth Hall, Honourable J. B. Simpson; Bunney Park, Lord Rancliffe; Clifton Grove, Sir Gervas Clifton; Clipstone Park, Duke of Portland; Clumber Park, Duke of Newcastle; Colwich Hall, John Musters, Esq.; Grave, A. H. Eyre, Esq.; Holme Pierrepoint, Earl Manvers; Hurgarton Hall, G. D. L. Gregory, Esq.; Kelham House, J. M. Sutton, Esq.; Langold, H. Gally Knight, Esq.; Lenton Priory, William Stretton, Esq.; Muskham, J. Pocklington, Esq.; Newstead Abbey, late Lord Byron (now the property of Major Wildman); Norwood Park, Sir Richard Sutton, Bart.; Osberton, F. F. Foljambe, Esq.; Ossington Hall, J. Denison, Esq.; Rufford Abbey, Honourable J. L. Saville; Stanford Hall, C. V. Dashwood, Esq.; Stappleford, Sir John Borlase Warren; Thoresby Park, Earl Manvers; Welbeck Abbey, Duke of Portland; Wollaton Hall, Lord Middleton; Worksop Manor, Duke of Norfolk.

NOVAIA, a small town of Tobolsk, in Asiatic Russia, situated on the Irtysch, one hundred miles east-south-east of Tobolsk.

NOVARA, a province of the duchy of Piedmont, in the continental dominions of Sardinia. It extends over 610 square miles, and comprehends one city, 117 market-towns and villages, and about 100,000 inhabitants. It is a level district, watered by the rivers Ticino, Sesia, and Agnona, the streams of which are spread by numerous small canals, so as to irrigate the whole of the surface; but as the water is not stagnant, the air is not generally insalubrious, excepting near the extensive rice-grounds. Much corn is raised, and some of the best silk, with hemp, flax, and fruits.

The capital is the city of the same name, situated on a

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hill at the foot of which flows the river Agnona; it is fortified, is the seat of a bishop, and has a cathedral. It contains several parish churches, seventeen convents for the two sexes, and two thousand houses, with 14,662 inhabitants. The city has two colleges and a theological seminary. The chief occupations of the inhabitants consist in weaving silk and linen, and some smaller trades. Long. 8. 32. 25. E. Lat. 45. 26. 58. N.

NOVA SCOTIA, a British province of North America, situated between the parallels of 43. 25. and 46. 0. north latitude, and the meridians 61. 0. and 66. 30. of west longitude, and connected with the south-east part of the continent by an isthmus of only eight miles in width. It is bounded on the north by the Strait of Northumberland, which divides it from Prince Edward Island; on the north-east by the Gut of Canseau, which interposes between it and the island of Cape Breton; on the south and south-east by the Atlantic Ocean; on the west by the Bay of Fundy; and on the north-west by New Brunswick. Its extreme length from Cape Canseau on the east to Cape St Mary's on the west is about 280 miles; but its breadth varies from fifty to about 100 miles, and it contains a superficies of about 16,000 square miles, or upwards of nine millions of acres. From this, however, nearly one third may be deducted for lakes, arms of the sea, and rivers, leaving about seven millions of acres of land, five millions of which may be considered as adapted for cultivation, and the remainder as affording tolerable pasturage. It is estimated that above three millions of acres of these lands still remain vacant, and in the hands of the crown; but the largest unoccupied tracts do not in one place exceed forty thousand acres.

The most remarkable physical characteristic of this peninsula of the North American continent is the numerous indentations along the coast. The shores are lined with rocks, and studded with thousands of small islands; and close to these, and in the harbours, almost without exception, there is a considerable depth of water. All along the southern shore there is a succession of noble harbours; and coasting vessels sail amongst and within the myriads of islands which line the coast during the most blustering weather, thus enjoying comparatively smooth water, whilst the main ocean heaves in violent agitation. The interior of the country is very agreeably diversified with hill and dale, river and lake, forest and grassy plain. The surface, although undulating, is not mountainous, the highest land, Ardoise Hill or Arthur's Seat, being only 810 feet above the level of the sea, nearly the same height as Arthur's Seat at Edinburgh. The highlands generally run north and south, branching off in all directions, and in some instances terminating in bold cliffs on the coast, the most remarkable of which is Aspotagoen, between Mahon and Margaret's Bay, which is about 500 feet in height. The Horton Mountains run nearly north and south; and the north mountains, which are washed by the Minas Basin, terminate in Cape Blomidon. The Blue Mountains, which lie in the interior of the counties of Annapolis, Shelburn, and Queen's, are said to retain traces of volcanic eruption. There is a great variety of rocks in Nova Scotia, but granite, trap, and clay-slate predominate. The most abundant variety is the gray granite, which prevails along the shore, and is well adapted for mill-stones. Trap rocks, sometimes interstratified with clay-slate, protrude in various places in immense parallel ridges above the surface, and frequently in piles of loose masses heaped confusedly together, traversed frequently by veins of quartz. Clay-slate of a very fine quality, and used as a building stone, prevails in the eastern section of the colony; and graywacke and graywacke-slate extend along both shores of Chedabucto Bay, in which are found beds of limestone and numerous species of specular iron ore. In connection with carboniferous limestone are found, both in Cape Breton and Nova Scotia, those immense coal fields which are supposed to rival in extent the mines of the mother country. Varieties of copper, iron, and lead ores are also abundant; and different other minerals of less importance are found. Salt springs, some of them strongly impregnated with saline matters, are met with near Pictou, at River Philip, and some other parts. The soil of Nova Scotia is of many different qualities, and various degrees of fertility. The alluvial, or intervale lands, of which there are extensive tracts, are rich, and produce plentiful returns of wheat, barley, oats, Indian corn, potatoes, turnips, with all the vegetables and fruits common in England. Some of the uplands, lying between the hilly country and the rivers, are light and poor, whilst the high lands are rich and very productive. The lands on the southern coast are generally so rocky as to admit of cultivation only at much expense and labour; but after the stones are removed, the soil is by no means barren.

The interior of Nova Scotia is intersected and watered by numerous rivers, lakes, and streams, which beautify and enrich the country. The two largest rivers are the Annapolis and the Shubneccadie. The former takes its rise in King's county, and, running parallel with the bay of Fundy, after a long and serpentine course, in which it receives the Moose and Bear Rivers, discharges itself into Annapolis Bay. It is navigable to a considerable extent, and its banks present a rich and pleasing landscape. The Shubneccadie, issuing from the Grand Lake in the county of Halifax, divides that county from Hants, and, after a rapid and circuitous course, the length of which has not yet been accurately ascertained, discharges itself into the Bay of Minas. It receives the waters of ten other rivers, is navigable for large vessels a long way into the interior, and contains on its banks inexhaustible quantities of gypsum and lime, together with extensive groves of fine timber. At Pictou, three rivers, navigable for large vessels, empty themselves into the harbour; the East, West, and Middle Rivers. Besides these, there are the Avon, navigable for a considerable distance; the La Have, which issues from a chain of interior lakes, and has a course of about sixty miles; the Mersey, which winds from Lake Rosignol through the Queen's county, and discharges itself into Liverpool Harbour; the Medway, the Shelburn, the Clyde, the Tusket, the St Mary, and others, all of which owe their origin to lakes in the interior. The most extensive still sheet of water is the Rosignol, situated partly in each of the three counties of Queen, Shelburn, and Annapolis. It is said to be thirty miles in length, but is little known. Lake George is also of considerable size; and there are innumerable others, which it is unnecessary to mention. The forests of Nova Scotia still constitute a prominent feature of the country. The trees are the same as those common to America, and the timber is generally large and lofty. Amongst the natural curiosities of this country is a huge granite stone, supposed to weigh about a hundred and sixty-four tons. It stands on the margin of a small lake, encircled with wood, near Halifax, and is so nicely poised on a flinty base of twelve inches, that the strength of one hand will put it in motion, but that of several hundreds could not shift it from its place. There are several remarkable caverns and grottoes, one of which, at St Peter's Point, on the coast of the Bay of Fundy, displays in the interior a spacious hall, the roof of which is fretted with stalactites; and brilliant gems are observed sparkling at the moment that the light of a torch or a candle approaches. The climate of Nova Scotia was for many years after its discovery considered as an insuperable barrier to agricultural industry, and an idea long prevailed in England that it was peculiarly the region of snow and fog. The temperature is indeed colder in winter in this peninsula than it is in Great Britain;

but when the weather is cold it is usually dry, and altogether the winter is milder, and the summer less intensely hot, than at Quebec. The summer heat is moderate and regular; the autumn is a delightful season; and there is seldom any severe winter weather until the end of December. Frost continues generally from Christmas to April, only interrupted by a thaw, which almost invariably takes place in January. The heaviest snow-storms occur in February. Rain falls in greatest abundance in spring and autumn; and a fog prevails on the south shore near the mouth of the Bay of Fundy, but does not extend far inland.

The wild animals are the moose, carriboo, bear, loup-cervier, tiger-cat, fox, marten, otter, mink, beaver, musk-rat, porcupine, racoon, wood-chuck, fisher, weasel, squirrel, hare, and the like, all of which, excepting the two last, have rapidly decreased in number. Nearly all the birds common to North America frequent Nova Scotia; and there are but very few kinds of fish which are found in the American seas that do not frequent the shores of this colony in vast swarms.

Nova Scotia is divided into ten counties, including Cape Breton; and the counties are subdivided into districts and townships as follows, viz. Halifax, divided into the districts of Halifax, Colchester, and Pictou, and containing the townships of Halifax, Dartmouth, Preston, Lawrence Town, Truro, Onslow, Londonderry, Pictou, Egerton, and Maxwelton; Lunenburg, containing the townships of Chester, Lunenburg, and Dublin; Queen's county, containing the township of Liverpool; Shelburn, containing the townships of Shelburn, Yarmouth, Barrington, Argyle, and Pubnico; Annapolis, containing the townships of Digby, Clements, Clare, Annapolis, Granville, and Wilmot; King's county, containing the townships of Aylesworth, Cornwallis, Horton, and Sherbrooke; Cumberland, containing the townships of Wallace, Amherst, and Pamborough; Hants, containing the townships of Falmouth, Windsor, Rawdon, Kempt, Douglas, and Newport; Sydney, divided into the Upper and Lower Districts, and containing the townships of St Mary's, Guysborough, Manchester, Wilmot, and Dorchester, or Antigonish; and Cape Breton, divided into the north-western, north-eastern, and southern districts. The townships are not all of equal extent, nor are there, as will be seen, the same number in each county. The inhabitants meet, like an English parish, in vestry, and assess themselves for the support of the poor. This regular subdivision affords facilities for the administration of justice; and the principal townships send representatives to the House of Assembly.

Halifax is the largest county in the province, stretching quite across it from the Atlantic Ocean to Cumberland Straits. It is bounded on the east by the county of Sydney, on the west by the counties of Hants and Lunenburg, and on the north by the county of Cumberland. The whole southern shore is washed by the Atlantic Ocean, and a part of the northern shore by Northumberland Straits. With the exception of the township of Halifax itself, the general appearance of the three districts into which the county is divided corresponds with that of the province as a whole; its surface being everywhere diversified by hill and dale, and well irrigated by rivers and brooks. All the southern part which lies upon the Atlantic is high, broken, rocky land, interspersed here and there with some good belts of soil, but in general it is barren and uncultivated. The extensive tract of country surrounding the Great Lake bears the same character, as does that which extends several miles along the eastern and western sides of the Shubneccadie River. Halifax, the capital city of the province, is situated on the south-east coast, in latitude 44. 40. north, and longitude 63. 40. west. It is built on the eastern side of a small peninsula, upon the declivity of a hill, which rises gradually from the water's edge; its length being about two miles, and its breadth about half a mile, with wide streets crossing each other at right angles, and containing nearly 2000 houses, and a population, including strangers, of about 20,000. It has been very much improved within the last ten years. The front of the town is lined with wharfs, alongside of which vessels of all sizes are continually discharging or taking on board their cargoes. The harbour of Halifax has perhaps not a superior in any part of the world, affording safe anchorage for a thousand ships at once; and it is accordingly the chief naval station of Great Britain in North America. It is accessible at all seasons of the year, being scarcely ever ice-bound, as Quebec annually is. It lies nearly north and south, extending in this direction about sixteen miles, and terminating in a beautiful sheet of water called Bedford Basin, within which are ten square miles of excellent anchorage. The bay from which the entrance of the harbour leads is formed between Sambro Head and Devil's Island, on the former of which a lighthouse was very early erected. There are four islands still farther in, upon the smallest of which, opposite the town, there are batteries strongly mounted, whilst several other fortifications command the harbour. A second lighthouse has been established on M'Nab's Island, situated near the mouth of the harbour. This island forms two entrances to the harbour; the eastern passage being for small vessels only, the other having depth of water for ships of all sizes. Above the wharfs already mentioned are numerous warehouses; and on the acclivity are the houses of the citizens, public buildings, and other structures. The houses are very irregular in height, but many of them are handsome stone and brick buildings, whilst those of wood are neatly faced with plaster or stucco. The public edifices are substantial, the Province Building in particular being one of the finest in our American colonies. It contains chambers for the council and legislative assembly, the supreme court, and all the provincial offices. The government-house, at the south end of the capital, is an antique baronial-looking edifice; and the military hospital, and other structures, are elegant and substantial. The dock-yard is one of the finest establishments out of Britain. There are a number of churches, and other places for public worship; and several markets, which are extremely well supplied with necessaries. Amongst the benevolent institutions of this city may be mentioned a college, which was established in 1820; and seven or eight newspapers, and a monthly magazine, are published. The intercourse between Halifax and Europe, America, the West Indies, &c. is regular and certain; and ever since its first settlement in 1749, it has continued to be of considerable importance, not only as a rendezvous for his majesty's ships, and as the head-quarters of the troops on the establishment of the lower American provinces, but also as the centre of a profitable fishery and trade. The manufactures carried on consist chiefly of sugar-refining, distillation of spirits, porter and ale brewing, and the making of soap, candles, leather, flour, and cordage, and a few other minor articles. Halifax is a free warehousing port, and its trade is very considerable.

Opposite to Halifax, on the eastern side of the harbour, stands the little town of Dartmouth. It was laid out about the time that the capital was founded, but in 1756 it was destroyed by the Indians, together with most of the inhabitants. It was subsequently resettled, and has slowly increased in population, and extended in size. The lands on the Dartmouth side of the harbour are much less stubborn than those on the opposite shore; and the industrious descendants of the original German settlers have long subjected them to a fair and profitable cultivation. The various other townships or settlements in the county of Halifax it is unnecessary to particularize individually.

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They all contain a considerable quantity of excellent soil, and a small town or hamlet where the settlers reside. Truro, situated on the southern side of Cobequid Bay, near its head, contains about one hundred houses, and a number of public buildings. The district of Pictou, which contains three townships, has a very good soil, and, besides a great coal-field, abounds with iron ore, copper, freestone, and lime. It has a number of excellent harbours, the principal port being called Pictou. It is admirably situated on the Straits of Northumberland, opposite Prince Edward Island, on the route from Halifax to Quebec, between which places there is not a safer or better shelter for ships. The town of Pictou, situated about two miles from the entrance, is well built, and contains four churches, with other public edifices, and about 3000 inhabitants. It is a free port, and its trade in lumber, coal, and the fishery, is considerable. An excellent newspaper is published at this place.

The county of Lunenburg is bounded on the north by King's county and that of Annapolis, on the south by the Atlantic Ocean, on the east by Halifax, and on the west by Queen's county. It extends forty miles from east to west, and its extreme width is thirty-five miles, exclusive of nearly three hundred islands scattered along its shores. The land is in general covered with spruce and fir timber, well watered, and capable of cultivation. The principal harbour is Mahon Bay, which is very extensive, and affords secure anchorage inside its numerous islands to vessels of the greatest magnitude. Chester town is situated on the north side of the bay, about nine miles from its mouth, upon a snug and commodious harbour. It is a thriving place, and carries on a very considerable lumber trade and fishery. It was first settled by people from New England, who afterwards abandoned the place. They were succeeded by Germans, who, being industrious, soon secured their own independence and the prosperity of the settlement. The population of the bay amounts to about 2000, who are chiefly employed in agriculture, preparing lumber for exportation at the saw-mills, and in fishery. Near the entrance of Mahon Bay, upon the western side, lies the harbour of Lunenburg, the county town. It is regularly constructed, and contains the county buildings, above 140 dwelling-houses, besides stores, and about 1400 inhabitants of Dutch and German origin. A few miles to the westward is La Have, one of the largest rivers in Nova Scotia, and settled principally by Germans, who own a number of saw-mills and grist-mills. The harbour is very spacious, consisting of an outer and an inner place of anchorage. Considerable quantities of fish are taken here, and several vessels are annually freighted with lumber and timber for Great Britain. Several islands well calculated for drying fish lie at the entrance, and they also form a protection to the shipping. Most of the islands in this county remain in their natural state; but one, called the Great Tancook, is settled, and contains thirty families.

Queen's county is bounded on the east by the county of Lunenburg, on the west by the county of Shelburn, on the north by the county of Annapolis, and on the south by the Atlantic Ocean. The interior of this county is stony, and generally incapable of cultivation. On the sea-board, however, it is better, and there are here several tracts of respectable soil, and some thriving settlements. Liverpool, the county town, and the second place in the province, is situated upon a harbour of the same name, about eighty miles west from Halifax. It is regularly laid out and well built, containing a court-house, jail, several places of public worship, a fort, above two hundred dwelling-houses, and a great many wharfs, stores, and other buildings. There is a good lighthouse at the entrance of the harbour, which never freezes over. The trade of the place is very flourishing, consisting chiefly in lumber and fish; but a considerable trade in timber is also carried on. Port Medway, into which the river Medway runs, is a very fine harbour, capacious, and safe. There are some other small settlements in this county, but none requiring special notice.

Shelburn county is bounded on the north by Annapolis county, on the south and west by the Atlantic Ocean, and on the east by Queen's county. It contains four townships, one of which, Yarmouth, comprises 100,000 acres of land, exclusive of lakes, of which Lake George is one. In the interior, this county remains, with few exceptions, in the state of a wilderness; but some parts are agreeably diversified, and in point of scenery it is one of the most beautiful portions of Nova Scotia. Shelburn, the shire-town, is built upon a harbour of the same name, which is esteemed one of the best in America. It has a lighthouse at the entrance, and is twelve miles in length, easy of access, and perfectly secure, affording anchorage for the largest vessels. This town was at one time of considerable importance, containing, it is said, about 12,000 inhabitants; but the population does not now exceed 500. A few miles westward of Shelburn is Cape Negro Harbour, sheltered by a high island of the same name. It forms the embouchure of the river Clyde, which winds forty miles through the county, has finely wooded banks, and, next to Annapolis, the most beautiful stream in the province. Within Cape Sable Island, the most northern point in Nova Scotia, is Barrington Harbour, where fishing to a considerable extent is carried on. Yarmouth or Cape Fourché Harbour is the principal and most thriving place in this part of the province. Its harbour is large, well sheltered, safe, and navigable for ships up to Yarmouth village. Yarmouth and its neighbourhood contain an industrious population of about 4500 inhabitants, who possess about seventy vessels and large stocks of cattle. It has always gone on steadily improving, and promises, from its numerous local advantages, to become a place of considerable importance. Shebogue River, in this part of the province, is navigable for seven miles from the sea, and at its mouth expands into a good harbour.

Annapolis county is bounded on the north and west by the Bay of Fundy, on the south by Shelburn, Queen's, and Lunenburg counties, and on the east by King's county. The first European settlements in Nova Scotia were established in this county by the French, who made some very extensive improvements. They founded Annapolis, the county town, and gave it the name of Port Royal. It is built upon a peninsula, which, projecting into the river of the same designation, forms two beautiful basins, one above and another below the town. Although once the metropolis of Nova Scotia, it is not now more than a thriving village, containing about sixty dwelling-houses, with the government buildings, several places of public worship, and some stores. The trade is comparatively insignificant, and arises principally from the fishery. Digby, which has sprung up into a town within the last fifty or sixty years, is a much larger place, containing about two hundred houses. The inhabitants here and in the neighbourhood are principally engaged in the cod and mackerel fishery along the coast. Bridgetown, another thriving village, is situated at the head of the navigation of the river, and from this place the produce of the inland districts is shipped for exportation. Fish of various kinds, such as shad, bass, salmon, and particularly herring frequent Annapolis basin. About seven miles from Annapolis, on a stream called Moose River, an iron foundery has been established by a company under the protection of a legislative charter. The buildings are extensive and substantial, and the iron ore is excellent; but a similar work at Pictou possesses the great advantage of a coal mine in the immediate vicinity. The basin of Minas, in this county, is one of the two great

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branches of the Bay of Fundy. Its entrance is through a strait about three miles in width, with bold, abrupt shores, within which it widens from eight to sixteen miles, and, receiving the waters of upwards of twenty rivers and streams, extends about fifty miles to the head of Cobequid Bay. The tide rises sometimes so high as seventy feet in the bay, and flows with great rapidity, particularly when under the influence of high winds. The other townships of this county are thriving places, containing from 1000 to between 3000 and 4000 inhabitants.

King's county is bounded on the south by the counties of Lunenburg and Hants, on the north by the Bay of Fundy, on the east by Cumberland county, and on the west by that of Annapolis. The township of Horton, in this county, contains about 4000 acres of diked land, besides intervale and salt marshes; and the upland, which is hilly and broken, consists mostly of good tillage land. The principal town is Kentville, on the borders of Cornwallis, containing several good private houses, a court-house, a jail, and a grammar school. The township of Cornwallis is well watered by several rivers, and the land throughout is of the very best quality, being so fertile as to have obtained the name of the garden of the province. The township of Aylesford is similar to it in soil and productions; but that of Parrsburgh is much broken and hilly, although in many parts the soil is excellent.

Cumberland county is bounded on the north-west by the Chignecto Channel, the Missiguash River, and part of New Brunswick; on the east by the straits of Northumberland; on the south-east by the county of Halifax; and on the south-west by King's county. The soil of this county is various, containing a considerable portion of excellent land, with some that is not so productive. On the shore of the Chignecto Channel and Cumberland Basin there are considerable tracts of valuable marsh land. The upland is in general of very superior quality, and there are several thousand acres of dike land of the most productive description. Coal, lime, and gypsum, are found almost everywhere; and iron and copper ores have been discovered at several places. Rivers and streams traverse the county in almost every direction, and it has several fine harbours on both its shores. It contains a number of thriving settlements, particularly those of Fort Lawrence, Amherst, Wallace, and West Chester; but none of the towns requires particular notice.

Hants county is bounded upon the north by the Minas Basin, on the east by Shubneccadie River, which separates it from Halifax, on the south by parts of the counties of Halifax and Lunenburg, and on the west by King's county. This county contains a considerable quantity of the very finest soil, and is well settled throughout. Windsor, the shire-town, is situated at the confluence of the Avon, Windsor, and St Croix Rivers, and is a neat, well-built place, containing about one hundred and thirty dwelling-houses, and a number of public buildings, particularly an university, King's College, an academy called the Collegiate School, and several places of worship. This is the only town in the county, the other settlements being small hamlets planted in positions favourable for agriculture or fishing.

Sydney county, forming the most easterly part of the province, is bounded on the west by the county of Halifax; on the south by the Atlantic Ocean; on the east by Chedabucto Bay, the Gut of Canseau, and St George's Bay; and on the north by Northumberland Straits. It is divided into an upper and a lower district, the former being, in an agricultural point of view, far superior to the latter; and, notwithstanding the numerous and beautiful harbours on the bays and coasts, and the valuable fisheries, it is much more populous. The village of Dorchester, situated about a mile above the navigation on Antigonish River, is the principal trading place in the district. The lower district of Sydney extends on its interior or northern boundary about forty miles, and on its western side (on the sea coast) about one hundred and twenty miles. No part of Nova Scotia, and perhaps few countries in the world, can boast of so many excellent harbours in the same extent of coast. Many of them are navigable for the largest vessels, and numbers affording safe and extensive anchorage-ground for ships of moderate size occur at intervals of only a few miles. The soil along the shore being stubborn, the agricultural resources of this part of the county are inferior to those of the upper district; but it possesses much greater facilities for commerce and navigation, and its fisheries are the best in the province.

For a general description and history of Cape Breton, the reader is referred to the article Breton, Cape. In many respects it bears so close a resemblance to Nova Scotia as to supersede any further description. The staple products of the island are fish, coal, gypsum, and timber. In 1832 the exports were, timber, 9500 loads; coals, 22,911 chaldrons; pickled fish, 21,000 barrels;[1] dried fish, 44,000 quintals; oil, 2500 barrels; live stock, 820 head; oats, 6000 bushels; potatoes, 13,000 ditto; total value, L.780,000. The imports, consisting chiefly of British manufactures, amount to nearly the same sum. The revenue, amounting to about L.4000 a year, is expended in salaries to a few public functionaries, in improving roads, and for other purposes. This island is incorporated with Nova Scotia, and contains about 30,000 inhabitants, who send two members to the Provincial Assembly.

Sable Island, although distant about eighty-five miles from Nova Scotia, is considered as belonging to that province. It lies directly in the track of vessels bound to or from Europe, and has been the scene of numerous and melancholy shipwrecks. Within a few years forty vessels have been wrecked on it; and in one year two hundred people perished on its shores. It is thirty miles in length by about one and a half in breadth, the west end being in latitude 43. 56. 42. north, and longitude 60. 71. 15. west; and the eastern end in latitude 43. 59. 5. north, and longitude 59. 42. west. It is a barren desert throughout, the soil consisting chiefly of sand, and the only vegetable productions being a coarse grass and some wild berries. A sum of L.800 is devoted to keeping on the island a superintendent from Nova Scotia, with a party of men provided with provisions and other necessaries, for the purpose of affording assistance to any shipwrecked mariners, of whatsoever nation, who may be driven upon its inhospitable shores. There is a small stock of cattle on the island, but the chief supplies of food are obtained from Nova Scotia.

Agriculture was long almost entirely neglected in Nova Scotia, as other pursuits afforded a more immediate return for labour and capital. In fact, the cultivation of the soil was looked upon as rather a degrading employment, and ranked far below that of the petty shop-keeper or itinerant pedlar. In 1817, however, a board of agriculture was formed, the objects of which were, the encouragement of agriculture on the most approved system; the improving of the breed of horses, and of all kinds of live stock; the importing of the best kinds of seeds, and the awarding of prizes to those who should excel in these various departments. Under the auspices of this society and its numerous branches, agriculture has made greater advances than could have been anticipated from the contempt in which it had previously been held; but still farming operations are rather clumsily conducted.

[1] A great part of the fish taken here is transported directly to Halifax, and therefore does not appear in the Cape Breton returns.

Nova Scotia.

The soil will produce, and the climate ripen, all the agricultural productions of England in great perfection, so that it is unnecessary to specify individual crops. The province is well stocked with horses, horned cattle, sheep, and swine; and the last species of stock has more than doubled within the last twenty-five years. There are few manufactures, properly so called, carried on in Nova Scotia; but the preparation of lumber and ship-building are sometimes so denominated. Saw-mills abound in every district, and the quantity of lumber prepared and exported is immense. Ship-building is carried on to a great extent. The average quantity has been estimated at 10,000 tons per annum, principally sloops, schooners, and vessels for the fisheries. The total quantity of timber shipped from the colony in 1833 was valued at L.62,447. The total value of the produce of the mines exported was L.105,329, and of the fisheries L.127,455. There were exported besides, beef, pork, flour, grindstones, gypsum, and other articles, to the value of L.592,136, making the total amount of exports L.887,367. The following parliamentary return presents a tabular view of the exports from Nova Scotia, exclusive of Cape Breton, for several years ending 5th January.

	1830.	1831.	1832.	1833.	1834.	
Seal skins	14,913	3,365	49,412	51,918	22,229	number.
Oil	618	715	694	704	596	tons.
Fish, dry	158,289	151,807	161,174	160,640	232,269	quintals.
Ditto, pickled	45,741	45,433	52,063	36,070	53,128	barrels.
Ditto, ditto	3,416	2,999	3,200	2,168	1,470	half ditto.
Timber, &c.	25,182	26,182	33,261	38,192	36,386	tons.
Gypsum	28,059	44,253	47,857	45,058	93,962	ditto.
Boards and planks	12,450,250	9,876	8,833	9,984	14,774	feet.
Vegetables	68,213	63,503	58,691	64,712	75,592	bushels.
Spars	976	1,322	689	1,689	2,366	number.
Staves	4,068	3,051	2,386	2,714	3,133	thousands.
Grindstones	...	...	...	2,192	36,386	tons.

The fish is thus the staple article of the trade of this province. The fishery is carried on principally on the eastern shore, in and about Chedabucto Bay; on the southern shore, at Lunenburg, Liverpool, and Shelburn; on the western shore, at Yarmouth, Clare, Argyle, and Barrington; and at Annapolis, in the Bay of Fundy. The fish principally taken are cod, herrings, mackerel, shad, alewives, and salmon. The British fishermen complain much of the injuries which they receive from the French and Americans, who are permitted to fish upon the coasts of our North American colonies.

The imports of Nova Scotia consist chiefly of British manufactures and spirits, sugar, wines, and other articles from our colonies. The following is an abstract of goods imported between the 31st of December 1832, and the 31st of December 1833, for which duties were paid or secured at the excise office, including the island of Cape Breton:—Wine, 113,671 gallons; rum, brandy, and gin, 887,352 gallons; sugar, 41,990 cwts.; beef and pork, 6016 pounds; flour, 32,263 pounds; tobacco, 186,690 pounds. The amount of goods imported, paying *ad valorem* duties, was L.347,388, and the amount of duties levied was L.105,386. The total value of the importations for that year was L.1,035,660.

With regard to the shipping of the colony, the total number of vessels inwards in 1833 was 1950, of 163,385 tons; and in 1834, 3068, of 253,921 tons. The total number outwards in 1833 was 2330, of 179,956; and in 1834, 3116, of 250,239 tons. They belonged chiefly to Great Britain and the British colonies. To show the increase of trade, it may be stated, that in 1807 the shipping entering Nova Scotia was not more than 25,000 tons.

The revenue of Nova Scotia is chiefly derived from the custom and excise duties above mentioned, to which are added other items of small amount derived from the sale of crown lands, which in 1831 realized L.645, and in 1832, L.1063; from the rent of the coal-mines, which is upwards of L.4000 per annum; and from the lighthouse dues, which amount to an annual average of L.2000. According to a document first printed in Mr Montgomery Martin's work on the British colonies, the revenues for a series of years were as follow:—

Years.	Colonial Gross Revenue.	Parliamentary Grants.	Total.
	£	£	£
1821	31,430	...	31,430
1822	32,097	...	32,097
1825	37,004	9,395	46,399
1826	38,360	11,245	49,605
1827	59,886	...	59,886
1829	81,887	13,998	95,885
1830	52,030	16,245	68,275
1831	85,018	13,125	98,143

The colony of Nova Scotia is quite adequate to defray all its civil expenditure, and the parliamentary grants, much of which had been applied to clerical purposes, were nearly all withdrawn in 1833, with the exception of that given to the Society for the Propagation of the Gospel. In 1831 the civil and military expenditure amounted to L.94,876, which was less than the revenue. Besides the salaries of the different functionaries, a considerable sum has been laid out annually in making and repairing roads and bridges, keeping up lighthouses, and for the purposes of religion and education. The established church is Episcopalian, and under the management of a bishop, archdeacon, and thirty-two clergymen, who by the last census had under their charge 28,659 people. Of the church of Scotland there are twelve ministers, having 37,227 hearers. Of the Roman Catholic church there are a bishop and fourteen priests, with 20,401 members. There are, besides, 19,790 Baptists, 9408 Methodists, 2968 Lutherans, 4417 dissenters from the church of England, 405 from the church of Scotland, 153 Quakers, and some few other persuasions. About 50,000 acres of land have been granted for the support of religion and schools. For the year ending November 1832 there were in the province 420 schools, at which 11,771 scholars attended; and independently of these there were twenty-four grammar-schools. Dalhousie College, at Halifax, is in constitution similar to the University of Edinburgh. There is a fine institution, called King's College, at Windsor, with regularly educated professors and others; and Pictou College is likewise an excellent institution.

Nova Scotia is governed by a lieutenant-governor, council, and house of assembly. The president of the council is the chief justice of the province; the next in station is the bishop, and there are ten other members. The house of assembly contains forty-two members, each of the ten counties returning two, except the county of Halifax, which returns four, and the town of Halifax two; seventeen other towns return each a member, and the island of Cape Breton sends two. The house of assembly act, and the laws are administered, as in Canada. There is a strong body of militia for the defence of the province, the name of every male from sixteen to sixty being enrolled. The king's troops consist of artillery and engineer detachments, and two regiments of infantry. Halifax is the chief naval station for the West Indies and North America, the commander-in-chief being a vice-admiral, with a suitable fleet. The forts protecting Halifax town and harbour are strong, and the interior of the country is well guarded by the militia.

By the last census, which was taken in the year 1827, the population, exclusive of Cape Breton, was 123,848. In 1837 it cannot be estimated under 145,000; for during the last ten years a great quantity of land has been sold, and a number of settlers have gone out, whilst the revenue has also greatly increased. The inhabitants consist of natives, the descendants of Europeans, English, Scotch, Irish, Americans, loyalists, Germans, Acadian French, Indians, and freed negroes. They mingle and live together in much harmony, and, generally, the social state of this province is rapidly improving. Its prosperity has greatly increased; and, instead of importing, it now exports provisions. Its fisheries, to which proper attention is at length paid, its rich and prolific soil, and its mines of coal and iron, are sources of wealth which were too long neglected by Great Britain.

Our limits will only admit of a brief abstract of the history of Nova Scotia. Ancient authorities state that it was discovered by the Cabots in 1497; but it was not until 1604 that the French attempted to form settlements. They were, however, expelled from it by the English colonists of Virginia, who claimed the country in right of the discovery of Sebastian Cabot. In 1621, Sir William Alexander obtained a grant of the whole peninsula, and it was named in the patent Nova Scotia, instead of Acadia, as the country was called by the French. In the mean time, the latter obtained a footing in it a second time; and it was not until 1654, when a strong force was despatched by Cromwell, that the French settlers were brought under subjection. In 1667, Nova Scotia was ceded to France by the treaty of Breda; but, after suffering during the war which broke out in 1701, as well as previously, it was finally ceded to England by treaty in the year 1711. From this period till 1749 it was neglected by Great Britain; but the designs of the French called the attention of government to the province. Encouragements were held out to settlers, parliament gave a large grant, and about 4000 adventurers with their families embarked for the colony. Halifax was immediately founded; but the French settlers, under the name of neutrals, were still very numerous; and, with the aid of the Indians, they inflicted repeated injuries upon the British, until they were forcibly expelled by the latter. In 1758 a constitution was granted to Nova Scotia; and the capture of Louisburg, in the island of Cape Breton, during the same year, gave additional security to the colony, which now began to improve. By the treaty of Paris, 10th of February 1762, France resigned all further claims on any of her former possessions in North America, and nothing of any material importance has since occurred. New Brunswick and Cape Breton were separated into two distinct governments in 1784, and the latter was re-annexed to Nova Scotia in 1819. This the colonists strongly protested against, and applied to government to allow them to remain as a separate province; but, as might have been expected, their application proved unsuccessful. (R. R. R.)

Novatian || Novation.

NOVATIAN, a priest of Rome, but originally a pagan philosopher. He was baptized in bed when dangerously ill; having recovered, he was afterwards ordained priest through the favour of his bishop, although the clergy and the people were far from being disposed to grant it. He does not appear to have had the good of the church much at heart; for, with his wit, knowledge, and eloquence, he might have been peculiarly serviceable to her, had he not meanly shrunk from his duty when he dreaded persecution. His ambition to be a bishop likewise misled him; and the circumstance which occasioned the apostacy of most of the first heresiarchs also occasioned his. On the death of Fabian, bishop of Rome, Novatian, after writing a letter to St Cyprian, remained quiet whilst the see was vacant; but the promotion of Cornelius excited his envy and jealousy to the highest pitch. The consequence was a separation from the new bishop, and from those who professed to believe, what Novatian strenuously denied, that the church could receive those again who had been guilty of idolatry. He soon got together a number of followers amongst the laity, and some even amongst the clergy. Novatus, a priest of Carthage, was one of his party, and having been opposed to St Cyprian, brought his adherents with him. In an infamous and clandestine manner he got himself consecrated bishop of Rome, by three weak men, whom he had grossly imposed upon; and one of them afterwards did penance for having been concerned in what was so contrary to order, decency, and the rules of the church. His designs, however, in this disgraceful affair did not succeed; for he was not acknowledged as bishop of that diocese, Cornelius being confirmed in it, whilst he was condemned and excommunicated. He still, however, taught his doctrine, and at length became the head of the party which bears his name. St Jerome says he wrote on the Passover, on the Sabbath, on Circumcision, on the high priests, on prayer, on Jewish meals, and on firmness of mind, besides a large treatise on the Trinity. But none of these works appears under his own name, and some are thought not to be his.

NOVATIANS, *Novatiani*, a sect of ancient heretics, who arose towards the close of the third century, and were so called from Novatian, a priest of Rome. They were also denominated *Cathari* or Puritans. Novatian first separated from the communion of Pope Cornelius, on pretence of his being too easy in admitting to repentance those who had fallen off in times of persecution. Novatus coming to Rome, joined himself to the faction of Novatian, and both maintained that there was no other admission into the church but by the repentance in baptism, grounding their opinion on the words of St Paul: "It is impossible for those once enlightened, and who have tasted the heavenly gift, if they fall away, to renew themselves by repentance." Not that they denied but a person who had fallen into any sin, however grievous, might obtain pardon by repentance; for the Novatians themselves recommended repentance in the strongest terms. But their doctrine was, that the church had not the power to receive sinners into its communion, as having no way of remitting sins but by baptism, which, once received, could not be repeated. In process of time the Novatians softened and moderated the rigour of their master's doctrine, and only refused absolution to very great sinners. The two leaders were proscribed, and declared heretics, not for excluding penitents from communion, but for denying that the church had a power of remitting sins.

NOVATION, or INNOVATION, in the *Civil Law*, denotes the change of one kind of obligation for another; as when a promise is accepted instead of a written obligation.

NOVATUS, a priest of Carthage in the third century, who, to avoid being punished for a crime, joined with the deacon named Felicissimus against St Cyprian. In 251 he went to Rome, and there found Novatian, who had acquired great reputation by his eloquence, but who murmured at his not being raised to the see of Rome in preference to Cornelius. Novatus soon contracted a friendship with him, and afterwards promoted the consecration of Novatian. This irregular proceeding produced a very great schism. Novatus also maintained that the church had not the power to receive those into communion who had fallen into idolatry.

NOVEL, a fictitious narrative in prose, which professes to exhibit the natural workings of the human heart, the happiness and misery of private life, and, above all, the nature of the affection called love, and the consequences of indulging it in certain circumstances. A critic, by no means too indulgent to works of fancy, and amongst whose failings laxity of morals has never been numbered, thus expresses himself on the subject of novel-writing. "These familiar histories," says Dr Johnson, "may perhaps be made of greater use than the solemnities of professed morality, and convey the knowledge of vice and virtue with more efficacy than axioms and definitions. But if the power of example is so great as to take possession of the memory by a kind of violence, and produce effects almost without the intervention of the will, care ought to be taken, that, when the choice is unrestrained, the best examples only should be exhibited; and that what is likely to operate so strongly, should not be mischievous or uncertain in its effects."

We have said that the novel professes above all things to exhibit the nature of love, and its consequences. Whether this be essential to such performances, may perhaps be reasonably questioned; but it has been made an important part of the drama in most novels, and, we think, with great propriety. It is the object of the novellist to give a true picture of life, diversified only by accidents that daily happen in the world, and influenced by passions and qualities which are really to be found in conversing with mankind. To accomplish this object, he conceives a hero or heroine, whom he places in a certain rank of life, endows with certain qualities of body and mind, and conducts, through many vicissitudes of fortune, either to the summit of happiness or to the abyss of misery, according to the passion which he wishes to excite in his readers. In the modern novel, this hero or heroine is never placed on a throne or buried in a cottage; because to the monarch and the cottager no difficulties occur which can deeply interest the majority of readers. But amongst the virtuous part of the intermediate orders of society, that affection which we call *love* seldom fails, at some period of life, to take possession of the hearts of both sexes; and wherever it has place, it must be productive of happiness or of misery. In the proper management of this passion consists much of the difficulty of the novel writer. He must exhibit his hero as feeling all the pangs and pleasures of love, as sometimes animated with hope, and sometimes ready to sink into despair, but always exerting himself to obtain the gratification of his wishes. In doing this, care should be taken, either that he never transgress the laws of virtue, or that at least he never transgress them with impunity.

"It is justly considered," says the writer above quoted, "as the greatest excellency of art to imitate nature; but it is necessary to distinguish those parts of nature which are most proper for imitation: greater care is still required in representing life, which is so often discoloured by passion or deformed by wickedness. If the world be promiscuously described, I cannot perceive of what use it can be to read the account; or why it may not be as safe to turn the eye immediately upon mankind, as upon a mirror which shows all that presents itself without discrimination. It is therefore not a sufficient vindication of a character, that it is drawn as it appears; for many characters ought never to be drawn: nor of a narrative, that the train of events is agreeable to observation; for that observation which is called knowledge of the world will be found much more frequently to make men cunning than good. The purpose of these writings is surely not only to show mankind, but to provide that they may be seen hereafter with less hazard; to teach the means of avoiding the snares which are laid by treachery for innocence, without insuring any wish for that superiority with which the betrayer flatters his vanity; to give the power of counteracting fraud, without the temptation to practise it; to initiate youth, by mock encounters, in the art of necessary defence; and to increase prudence without impairing virtue.

"Many writers, for the sake of following nature, so mingle good and bad qualities in their principal personages, that they are both equally conspicuous; and as we accompany them through their adventures with delight, and are led by degrees to interest ourselves in their favour, we lose the abhorrence of their faults, because they do not hinder our pleasures, or perhaps regard them with some kindness for being united with so much merit. There have been men indeed splendidly wicked, whose endowments threw a brightness on their crimes, and whom scarce any villany made perfectly detestable, because they never could be wholly divested of their excellencies: but such have been in all ages the great corrupters of the world; and their resemblance ought no more to be preserved than the art of murdering without pain.

"In narratives, where historical veracity has no place, there should be exhibited the most perfect idea of virtue; of virtue not angelical, nor above probability (for what we cannot credit we shall never imitate), but the highest and purest that humanity can reach, which, exercised in such trials as the various revolutions of things shall bring upon it, may, by conquering some calamities and enduring others, teach us what we may hope, and what we can perform. Vice (for vice is necessary to be shown) should always disgust; nor should the graces of gaiety, or the dignity of courage, be so united with it as to reconcile it to the mind. Wherever it appears, it should raise hatred by the malignity of its practices, and contempt by the meanness of its stratagems; for while it is supported by either parts or spirit, it will seldom be heartily abhorred."

It is farther observed by Johnson, that the task of the novel writer "requires, together with that learning which is to be gained from books, that experience which can never be attained by solitary diligence, but must arise from general converse and accurate observation of the living world. Their performances have, as Horace expresses it, *plus oneris quantum variæ minus*, little indulgence, and therefore more difficulty. They are engaged in portraits of which every one knows the original, and can detect any deviation from exactness of resemblance. Other writings are safe, except from the malice of learning, but these are in danger from every common reader; as the slipper ill executed was censured by a shoemaker who happened to stop in his way at the Venus of Apelles.

"But the fear of not being approved as a just copier of human manners, is not the most important concern that an author of this class ought to have before him. Novels are written chiefly to the young, the ignorant, and the idle, to whom they serve as lectures of conduct and introduction into life. In every such work, it should therefore be carefully inculcated, that virtue is the highest proof of understanding, and the only solid basis of greatness; and that vice is the natural consequence of narrow thoughts; that it begins in mistake, and ends in ignominy; and since love must be introduced, it should be represented as leading to wretchedness whenever it is separated from duty or from prudence."

For some striking and profound observations on the effects of novel-reading, the reader is referred to what Mr Stewart has written upon that subject in his Elements of the Philosophy of the Mind. See the article ROMANCES.

NOVEL, in the civil law, a term applied to the constitutions of several emperors (*novellæ constitutiones*), more particularly those of Justinian. See CIVIL LAW.

NOVELTY, or NEWNESS. Of all the circumstances which raise emotions, not excepting beauty, nor even greatness, says Lord Kames, novelty has the most powerful influence. A new object produces instantaneously an emotion termed wonder, which totally occupies the mind, and for a time excludes all other objects. Conversation amongst the vulgar never is more interesting than when it turns upon strange objects and extraordinary events. Men tear themselves from their native country in search of things rare and new; and novelty converts into a pleasure the fatigues and even perils of travelling. To what cause shall we ascribe these singular appearances? To curiosity, undoubtedly; a principle implanted in human nature for a purpose extremely beneficial, that of acquiring knowledge; and the emotion of wonder raised by new and strange objects inflames our curiosity to know more of such objects. This emotion is different from admiration. Novelty, wherever found, whether in a quality or action, is the cause of wonder; admiration is directed to the person who performs any thing wonderful.

The pleasure of novelty is easily distinguishable from that of variety. To produce the latter, a plurality of objects is necessary; the former arises from a circumstance found in a single object. Again, where objects, whether co-existent or successive, are sufficiently diversified, the pleasure of variety is complete, though every single object of the train be familiar; but the pleasure of novelty, directly opposite to familiarity, requires no diversification.

However natural novelty may be, it is matter of experience, that those who relish it the most are careful to conceal its influence. Love of novelty, it is true, prevails in children, in idlers, and in men of shallow understanding; and yet, after all, why should one be ashamed of indulging a natural propensity? A distinction will afford a satisfactory answer. No man is ashamed of curiosity when it is indulged to acquire knowledge. But to prefer any thing merely because it is new, shows a mean taste, which one ought to be ashamed of. Vanity is commonly at the bottom, and leads those who are deficient in taste to prefer things odd, rare, or singular, in the hope of distinguishing themselves from others. In fact, this appetite reigns chiefly amongst persons of a mean taste, who are ignorant of refined and elegant pleasures.

Of this taste we have some memorable instances in men of the highest and the best education. Lucian tells a story of Ptolemy I. which is as disgraceful to him as it is honourable to his subjects. This prince had ransacked the world for two curiosities; one was a camel from Bactria, black all over, the other a man half black half white. These he presented to the people in a public theatre, thinking they would give them as much satisfaction as they did him; but the black monster, instead of delighting them, affrighted them; and the party-coloured man raised the contempt of some and the abhorrence of others. Ptolemy, finding the Egyptians preferred symmetry and beauty to the most astonishing productions of art or nature without them, wisely removed his two anomalous trifles out of sight; the neglected camel died in a little time, and the man he gave for a song to the musician Thespis.

NOVEMVIRI, nine magistrates of Athens, whose government lasted but for one year. The first of them was called *archon*, or prince; the second *basileus*, or king; the third *polemarchus*, or general of the army; the other six were called *thesmothetæ*, or lawgivers. They took an oath to observe the laws, and, in case of failure, obliged themselves to bestow upon the commonwealth a statue of gold as large as themselves. Those who discharged their office with honour were received into the number of the senators of Areopagus.

NOVI, a city of the duchy of Genoa, in Italy, now belonging to Sardinia. It is situated on the great road to Piedmont, has a strong castle, several churches, and 5572 inhabitants, who prepare some of the best silk in the district, in which they have a brisk trade, as well as in colonial productions.

NOVICE, a person not yet skilled or experienced in an art or profession. In the ancient Roman militia, *novicii* or *novitii* were the young raw soldiers, distinguished by this appellation from the veterans. In the ancient orders of knighthood, there were novices or clerks in arms, who went through a kind of apprenticeship ere they were admitted knights.

NOVICE is more particularly used in monasteries for a religious person still in his or her year of probation, and who has not made the vows. In some convents the sub-prior has the direction of the novices. In nunneries the novices wear a white veil, the rest a black one.

NOVICIATE, a year of probation appointed for the trial of religious, whether or not they have a vocation, and the necessary qualities for living up to the rule, the observance of which they are to bind themselves to by vow. The noviciate lasts a year at least, in some houses more. It is esteemed the bed of civil death to a novice, who expires to the world by profession.

NOVOGOROD. See NOWOGOROD.

NOWADAH, a town of Hindustan, in the province of Bahar, fifty-four miles south-south-east from Patna. Near it there is a pass through the mountains. Long. 85. 40. E. Lat. 24. 54. N.

NOWAGUR, a town of Hindustan, in the province of Gundwana, situated on the north-west bank of the Mahanuddy River. It belongs to the Nagpore Mahrattas, and is thirty miles south-south-east from Ruttunpoor. Long. 82. 55. E. Lat. 21. 55. N.

NOWED, in *Heraldry*, signifies knotted, from the Latin *nodatus*; being applied to the tails of such creatures as are very long, and sometimes represented in coat-armour as tied up in a knot.

NOWOGOROD, a province of Great Russia, which takes its name from the city which is now its capital, but was formerly that of the whole of Russia. The governments of Olonez, Pskow, Twer, and a part of that of St Petersburg, were included in it, till the recent divisions of the empire were established. It now extends between 57. 18. and 61. 8. north latitude, and between 20. 4. and 29. 41. east longitude, over 56,616 square miles. It contains ten cities, and 7932 villages, which are formed into 690 parishes, having each a church. The inhabitants are 964,500, and almost exclusively adhere to the Greek worship. The face of the country is level, though it includes the Waldai Hills; but none of these is more than 300 feet above the level of the sea. The soil in the northern part is marshy, and chiefly covered with moss; but in the south there is some dry and good land, the cultivation of which rewards the labourer, and the province produces more corn, chiefly rye, than it consumes. It also yields flax, hemp, and much wood. The climate is severe, being nearly similar to that

Nowogorod || Nuayhas.

of St Petersburg. The fisheries on the rivers and lakes yield much subsistence. There is but little commerce, and none but domestic manufactures.

NOWOGOROD, a city of Russia, the capital of a province, and of one of the thirteen circles of the same name into which that province is divided. It is situated in latitude 58. 32. 31. north, and longitude 31. 14. 16. east. It is the seat of the military government of Twer, as well as of both the military and civil governments of the province in which it stands. The site is on the banks of the Wolchow, where the water of the Ilmen is received into that stream, forming a river of more than a mile in breadth. The antiquities of the city are more striking than its beauties. The cathedral, with its brazen gates, is an object of curiosity for its venerable age, as is the tomb of St John of Nowogorod, a saint to whose shrine numerous pilgrims resort. It contains fifty-eight stone and four wooden churches, three monasteries, and 1550 houses, with 10,100 inhabitants. Though ill built, and with irregular narrow streets, it has an imposing appearance at a little distance, from the numerous spires and cupolas which are displayed. The chief occupations of the people are making sail-cloth and tanning leather.

NOWOGOROD SEWERSK, a circle of the Russian province Tschernigow, extending in north latitude from 51. 51. to 52. 24. and in east longitude from 31. 51. to 34. 19. The capital is a city of the same name, situated on the river Desna, 751 miles from St Petersburg. It is surrounded with walls, and has a castle, but neither in a good state of repair. It contains 1600 ill-built houses, with 8300 inhabitants, who carry on no manufactures, and subsist by trading in the productions of the surrounding soil. Long. 32. 48. E. Lat. 52. 50. N.

NOWOSILL, a circle of the Russian province of Tula, extending from north latitude 52. 53. to 53. 36. and from east longitude 37. 10. to 37. 25. and containing 94,600 inhabitants. The capital is a town of the same name, situated on the river Narutsha, 736 miles from St Petersburg, and containing 200 houses, with 1560 inhabitants. Long. 36. 55. E. Lat. 52. 55. N.

NOWPOORAH, a town of Hindustan, in the Mahratta territories of the province of Khandesh, forty-six miles east from Surat. Long. 73. 45. E. Lat. 21. 6. N.

NOX, in fabulous history, one of the most ancient deities amongst the heathens. She was daughter of Chaos, and from her union with her brother Erebus she gave birth to the Day and the Light. She was also the mother of the Parcæ, Hesperides, Dreams; of Discord, Death, Momus, Fraud, &c. Nox is called by some of the poets the mother of all things, of gods as well as of men; she was worshipped with great solemnity by the ancients, and had a famous statue in the temple of Diana at Ephesus. It was usual to offer her a black sheep, as she was the mother of the Furies; and a cock was also presented to her, as that bird proclaims the approach of day during the darkness of the night. She is represented as mounted on a chariot, and covered with a veil bespangled with stars. The constellations generally went before her as her constant messengers. Sometimes she is seen holding under her arms two children, one of which is black, representing Death, and the other white, representing Sleep. Some of the moderns have described her as a woman veiled in mourning, crowned with poppies, and carried upon a chariot drawn by owls and bats.

NUAYHAS, or AGUE TREE, a name given by the Indians to a sort of bamboo cane, the leaves of which falling into the water, are said to impregnate it with such virtue that the bathing in it afterwards cures the ague. To dissolve coagulated blood, they use also a decoction of the leaves, giving it internally, and at the same time rubbing with it the bruised part externally. It is said that this plant bears its flowers only once in its life; that it lives sixty years before the flowers make their appearance; and that, when they begin to show themselves, it withers away in about a month afterwards, that is, as soon as it has ripened the seed. There appears to be something of fiction in the account given of this tree in the *Hortus Malabaricus;* but it seems certain, that the length of the stalk, or trunk, must be very great. In the gallery of Leyden there is preserved a cane of nuayhas twenty-eight feet long; and another not much shorter, and more than eight inches in diameter, may be seen in the Ashmolean Museum at Oxford.

NUBA, a race of black Pagans, in the neighbourhood of Sennaar, of whom we know nothing, except what has been stated by Bruce. That traveller passed a day or two amongst them in his way from Abyssinia; and he tells us that they are all soldiers of the *melek* or king of Sennaar, cantoned in villages, which surround the capital to the distance of four or five miles. They are not the aborigines of that part of Africa; but are either purchased or taken by force from Fazuclo, and the provinces to the south upon the mountains Dyre and Tegla.

The idolatry of the Nuba is described as a mixture of Tsabaism and statue worship; but what is very uncommon, their worship is chiefly addressed to the moon, whilst they pay no attention to the sun either rising or setting, advancing to the meridian or receding from it. It is an old observation, that the worship of every people is tinctured by their natural dispositions; and this is verified in the case of the Nuba. "That their worship is performed with pleasure and satisfaction, is obvious," says Bruce, "every night that the moon shines. Coming out from the darkness of their huts, they say a few words upon seeing her brightness, and testify great joy, by motions of their feet and hands, at the first appearance of the new moon." This is just what we should have expected from their gentleness and hospitality. They likewise worship a tree and a stone, but our author could never discover what tree or what stone; he only learned that neither of them exists in Sennaar, but in the country where the Nuba are born. Such of them as are natives of the villages where he saw them, become, like their masters, nominal Mahommedans.

Boundaries and extent.

NUBIA, an extensive country of Africa, bounded on the north by Egypt, on the south by Abyssinia, on the east by the Red Sea, and on the west by the great Libyan desert. It is difficult to fix the precise limits and extent of this vast region, which will be variously estimated, according as we confine Nubia to the mere valley of the Nile between the first cataract and Meroë, or take into the account, as ought certainly to be done, the adjacent desert. There is, in fact, no principle of unity according to which it can be described as a whole; but, looking rather to the country itself than to any arbitrary definition or limitation, it may be considered as included between the thirteenth and twenty-fourth degrees of north latitude, and the thirty-third and thirty-sixth degrees of east longitude, and consequently as having a superficial area of not less than 360,000 square miles.

General character of the country.

With the exception of the immediate banks of the Nile, which are rendered partially productive by laborious irrigation, Nubia consists almost entirely of rocky and sandy deserts. From the southern boundary of Egypt to Derr, the capital of Lower Nubia, the mountains press so closely upon the river, that there is but little ground upon either side for the purposes of agriculture; and the small portion which is capable of being cultivated appears to be diminishing, from the gradual encroachment of the sands, which the winds of the desert carry towards the stream. The peculiar structure of the valley through which the Nile here forces a passage, renders it obvious that there could not at any period have been a very dense population in this part of Nubia. But farther up the river, beyond the parallel of Wady Halfa, there is ample space for the powerful nations which are said to have flourished here in ancient times. At the second cataract immense plains stretch out from either margin of the stream, exhibiting, it is said, even in their present neglected condition, unequivocal indications of fertility; and as there seems to be little doubt that, in former ages, the annual inundation extended considerably beyond the limits of modern cultivation, so it may reasonably be presumed that, anciently, the country was much more productive and populous than in modern times, when the decrease of the inundation, and the continual encroachment of the moving sands on the side both of the Nubian and the Libyan deserts, have combined to produce the desolation which now prevails. At present the Nile seldom or never overflows its banks in this part of Nubia; and the portion of the soil cultivated is irrigated by means of *sakkeas* or Persian wheels, constructed for raising the water of the river to the level of the adjacent ground. The eastern bank of the Nile is much better adapted for cultivation than the western, being more easily irrigated by artificial means. But it is not a little remarkable, that all the splendid ruins for which this region is distinguished, and which exhibit so great labour, ingenuity, and skill, are found upon the opposite bank; a circumstance which seems to strengthen the presumption that Nubia was formerly much more fertile and populous than in the present day.

The country on the banks of the Nile is divided into a number of little independent principalities, each governed by its own *melek* or chief. But, taken as a whole, it is composed of two parts; Wady Kenous, and Wady Nouba. The former extends from the confines of Egypt on the south to Wady Seboua; and the latter, from which the general name of the country appears to have been derived, stretches as far as the frontier of Dongola. The chief distinction between these two parts consists in the circumstance, that the languages spoken in each are entirely different. The governors of the various districts are described as ferocious and arbitrary in their proceedings; rude in their treatment of strangers, whom they regard with suspicion; and addicted to most of the vices which are common amongst barbarians. They acknowledge a nominal subjection to the viceroy of Egypt, but seldom neglect any opportunity that offers of setting his authority at nought. Still, under the safeguard of his firman, Europeans may travel as far as Ibrim (the ancient *Primmis*) in perfect safety; but, beyond that point, they must lay their account with being exposed to the vexations and dangers usually incurred in visiting barbarous countries, especially in Africa. In the marauding, slave-hunting expedition of Ismael Pasha in 1821, the treatment which the natives everywhere experienced has had the effect of exasperating and confirming the hostility of all the tribes who inhabit the upper parts of Nubia; nor is it likely that the remembrance of the wanton aggression which was then made upon them will soon be effaced from their memories. Each of the Nubian sheicks pays an annual tribute to the viceroy of Egypt; or rather a certain sum is extorted as an acknowledgment of subjection, and the price of an immunity from a visit by the viceroy's troops.

The grain which forms the principal object of Nubian cultivation is dhourra, the *holcus arundinaceus* of the botanists. It is raised upon the patches of soil irrigated by means of the sakkeas or Persian wheels, of which there are from six to seven hundred between the first and second cataracts; and, when ground, it is formed into a cake somewhat resembling the Abyssinian *teff*. But as the people have no mills of any kind wherewith to grind it, this is usually effected by placing the grain in small quantities upon a large stone, and rubbing a smaller one over it until it is reduced to a sort of flour. If it be intended to produce bread of a superior quality, the dhourra is well washed, and then dried in the sun. But in general the people do not take this trouble; and the meal produced by their rude mode of grinding resembles a paste of the coarsest kind, mixed with chaff, sand, and dirt. It is usually placed in an earthen jar, and there left to ferment during twenty-four or thirty hours, after which time it acquires a subacid taste. No leaven is formed. A portion of the fermented pulp is merely poured upon an iron plate or stone placed over a fire, and in a few minutes it is baked into a cake; and this is repeated till the whole be baked. Cakes are usually brought hot to table, in a wooden bowl, with onion sauce, broth, milk, or butter poured on them; but some of a thinner kind, and well toasted, are prepared for the use of the caravans, and may be kept without being spoiled for several months. After the dhourra, the Nubians raise a crop of barley, French beans, lentils, and sometimes also of water-melons. Tobacco is everywhere cultivated, and constitutes the principal luxury of all classes, being either smoked, or sucked in a peculiar manner between the gums and the lip. Animal food is scarce, and seldom eaten, even by the chiefs or sheicks. The liquors used are palm wine, a spirit distilled from dates, and a sort of beer called *bouza*, which is made from dhourra. Excessive indulgence in these liquors is general throughout the whole country. The only fruit trees cultivated in Nubia are palms, but the soil is adapted for several others. Great sameness prevails in the vegetation of the desert, the trees being mostly acacias, tamarix, date, and domm palms.

Climate.

The climate of Nubia, though intensely hot in summer, is nevertheless remarkably healthy. This is no doubt a consequence of the extreme dryness of the atmosphere, occasioned by the absence of rain, and the absorbent qualities of the soil. The plague has seldom or never reached Wady Halfa, and beyond the second cataract it is entirely unknown. The small-pox, however, is a fearful scourge, and, owing to the ignorance and filthiness of the people, occasionally commits dreadful ravages. The houses of the Nubians are constructed of mud or of loose stones. The mud huts are roofed with dhourra stems or palm leaves, which in this climate are found to be a sufficient covering. The houses which are built of stones, being for the accommodation of the better class of inhabitants, commonly consist of two compartments, one for the male and the other for the female members of the family. The utensils of a Nubian household are few and wretched; half a dozen coarse earthen jars, some earthen plates, two stones for grinding dhourra, and a few round sticks, usually constituting their whole stock. From this an idea may be formed of the miserable condition of the inhabitants, as compared with those of any other country, Egypt only excepted.

Population.

Still the Nubians are generally well made, strong, and muscular, and have tolerably good features. The women are not handsome, but perfectly well formed, and in general remarkable for agreeable countenances and pleasing manners. They are also modest and reserved, and strictly observant of their conjugal duties. The domestic employments of the women consist chiefly in weaving coarse woollen mantles, cotton cloth for shirts, and mats of the date leaves; they also make drinking-bowls, and plates for containing the dhourra bread. A linen cap and a woollen cloth or mantle constitute the dress of the rich. The women usually wrap themselves in black woollen gowns; but children of both sexes run about quite naked. In ascending the Nile to Sukkat and Mahas, the dress becomes more and more scanty, and at length almost entirely disappears. The Nubians are seldom seen unarmed; indeed the first purchase made by a boy is that of a short crooked knife, which being fastened at the left elbow, is ready to be drawn on the slightest quarrel. Fire-arms are not common, and ammunition is very scarce. The inhabitants of the two divisions of Nubia, Wady Kenous and Wady Nouba, are almost constantly engaged in sanguinary quarrels; and when

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death ensues, as is not unfrequently the case, the family of the deceased may either demand the price of blood, or retain the right of retaliation, which may be enforced against the brother, son, or first cousin of the murderer, at the option of the avenger. The consequence of this is, that when a death has occurred in any of these quarrels, a whole family is often obliged to leave the country. Great numbers of the Nubians repair to Cairo, where they usually act as porters, and are esteemed for their honesty; but they always return to their native villages with the little property which they have saved in plying their humble vocation. The inhabitants of Derr-el-Mahas and the more southerly districts differ considerably from the other Nubian tribes. Their houses are constructed only of palm leaves, fastened to high poles, the extremities of which rise considerably above the roofs. The countenances of the people are much less expressive of good nature than in the lower parts of the country, and their character corresponds with this difference of expression. In colour they are perfectly black, and their lips are thick like those of the negro, but they have not the same flat nose and high cheek-bones. A number of the men, and even girls who have attained womanhood, go about quite naked. Burckhardt has described the king of the Mahas as a mean vulgar-looking black, attended by some half dozen naked slaves, armed with shields and lances. Mahas is the nearest place in the country of the blacks, from which slave traders proceed to Cairo, a distance of about a thousand miles.

Tract between the Nile and the Red Sea.

There is another part of Nubia which is well deserving of particular notice; we mean the vast tract of country extending from the Nile to the Red Sea, between the parallels of 23° and 15° of north latitude. Modern travellers have penetrated this extensive region only by one line, namely, that which is followed by the Nubian caravans proceeding from Egypt to Sennaar. It is described as throughout a complete desert, without even a single fixed habitation, but interspersed with *wadys* or valleys, producing some trees, shrubs, or grass, and usually containing a few wells or rills, which are resorted to by the wandering Arabs, and also by the caravans, for a supply of water. The want of this important article forms the chief danger attending the journey; but if due precautions be taken, and the water-bags be properly filled at the wells, travellers can never be reduced to a state of great suffering, as many days seldom elapse without the means of obtaining a supply. Burckhardt, after having passed through the deserts of Suez and Sinai, did not consider this tract as quite so dreary, although its aspect is much more rugged, being in general hilly. At the southern extremity of this desert, through which roam the Bishareen tribes, is the district of Berber, consisting of four large villages, the inhabitants of which are chiefly employed in carrying on the trade of Egypt and Arabia with the interior of Africa. The people are a very handsome race, of a reddish-brown colour; which, if the mother be a slave from Abyssinia, becomes a light brown, but if from the negro countries, extremely dark, indeed almost black. The men are somewhat taller than the Egyptians, and also better limbed, and more muscular. Their features bear no resemblance to those of the negro; the face being oval, the nose often perfectly Grecian, and the cheek-bones by no means prominent. They consider themselves as Arabs, not negroes, and are very careful in maintaining the purity of their race. A free-born Meyrefab never marries a slave, whether Abyssinian or negro, but always an Arab girl belonging to his own or to some neighbouring tribe. Few men have more than one wife; but every one who can afford it keeps a female slave or mistress, either in his own or in a separate house; and traders passing through Berber usually take a mistress during the period of their stay in the district. Drunkenness is the constant companion of this debauchery; and these dissolute habits produce the most pernicious effects on the morals and conduct of the people. Their character indeed is deformed by every degrading and debasing vice; they are noted for treachery and dishonesty; in the pursuit of gain they are restrained by no principle, breaking without scruple the most solemn engagements; and in transactions amongst themselves they commonly terminate every dispute by the law of the strongest. Quarrels are frequent and violent at drinking parties, and mostly end in bloodshed either with the knife or the sword. The principal scenes of these disorders are the *bouza* huts, which are kept by women of infamous character, by whom the liquor is also manufactured. Indeed no one ventures to enter one of these without his sword, and several persons of distinction have been killed in them. In a word, it is marvellous that a people so completely abandoned to the dominion of the most brutal passions have not long since been consumed by their own vices. Another part of this territory is the district of Taka, inhabited by the Bishareen Arabs. It is comparatively populous and fertile, differing in many respects from the other parts of Nubia; and through it passes the road to Souakin, followed by Burckhardt, the first who made us acquainted with Taka.

Government.

The government of Nubia, like that of Egypt, is essentially military. The officers, all of whom are Turks, decide every question connected with the revenues, and frequently interfere, in other affairs, with the decisions of the cadis or civil judges. The system of the government is to extort from the peasant the utmost possible amount in the shape of taxes, leaving him only what is considered a sufficient subsistence, which, as might be expected, is usually a most miserable one. In some places, indeed, if the peasants did not actually steal from their own fields, they could not exist; and although they bury their grain under ground, and by various other methods deceive their oppressors, yet numbers perish from the want of sufficient sustenance and clothing. A vast proportion of the peasants subsist on food which is more calculated for cattle than human beings; and even of this, bad as it is, they have rarely enough. The pasha has power enough to keep them in subjection, and by his extortions fills his coffers. He not only imposes enormous taxes on every article of produce, but obliges the people to cultivate whatever he chooses, and to take the price which he offers for the produce. He is the only purchaser of the grain, cotton, and indigo, the gum of Kordofan, ostrich feathers, and other articles. Slaves are almost the only commodity which the merchants are allowed to take in exchange for the manufactures which they carry to Kordofan and Sennaar; and even the wild animals of the desert, as the giraffe, form a government monopoly. The pasha is also the landlord or proprietor of this immense region; and the people are his slaves. His revenues are derived not only from the regular taxes, but likewise from his profits as a merchant, which are enormous, owing to the low rate at which he pays the peasants for their produce, compared with the high price at which he afterwards sells it to Europeans. This source of gain, however, is greatly diminished by the roguery of the different officers through whose hands the various commodities pass. From the highest to the lowest there is no exception in this respect; mahmours, nayrs, kiachefs, caimacans, and mallums or Coptic accountants, all concur in diminishing the amount, and sharing the plunder of the unhappy peasantry. The Copts employed in this department not only cheat the ignorant Turks, who generally cannot read their accounts, but often trade with the money of the treasury, and sometimes incur losses they are unable to make good; on which account numbers of them are always immured in the prisons of the viceroy.

Condition of the people in Upper Nubia.

But the peasants in Upper Nubia are free from these exactions, and therefore comparatively happy. It is no doubt true, that, instead of one dollar in money, two pieces of linen cloth, and a sheep, which was all they paid their ancient meleks, they are now obliged to pay fifteen dollars in cash and five in grain, being in all three hundred piastres, or ten times the amount of their former contributions; and they are likewise obliged to work instead of sleeping during the greater part of the day, as was formerly their custom when under their own chiefs. But the man who is at all industrious may nevertheless earn what is amply sufficient to afford him food, and such dress as he has been accustomed to. Each sakkea or Persian wheel is sufficient to water three quarters of a feddan of land, planted with indigo; and each feddan, when carefully irrigated, produces a hundred cantars of the herb, and sometimes more, being about seventy-five cantars for the extent of land which one wheel will water. The government pay the peasant 12½ Egyptian piastres for each quintal, or 937 piastres for the whole; which, at the current rate of the dollar in this country (fifteen piastres), is equal to 62½ dollars. If from this we deduct twenty dollars for the duty, there remains for the persons to whom the wheel belongs 42½ dollars, or 637 piastres; but as the calculation here made is at the lowest rate, two piastres a day may fairly be estimated as the clear gain of the peasantry by each water-wheel. This sum, small as it may appear, is sufficient for the support of one family, provided it contain five persons capable of putting their shoulders to the wheel; if it do not, however, two families must unite to make up this number. The immense expense of the water-wheel forms a great deduction from the gain of the peasant in Egypt; but in Nubia they are so much more simple that they cost only a trifling sum, as oxen may be obtained for thirty piastres each, whilst their "keep" is next to nothing. Two piastres, or sevenpence sterling, may appear a very small sum to a European; but in this country, where every necessary is so cheap, it is amply sufficient for the support of a family. In both divisions of Egypt, where bread is much dearer, and meat and milk are double the price, the fixed remuneration of a labourer amounts to only half a piastre per day, with which he has to sustain himself and perhaps a family. But in Nubia most of the peasants have slips of land watered by the partial inundation of the river, and gain considerably by their date trees, although they pay a tax of a piastre for each. They also rear flocks; cultivate vegetables, particularly bamia and malakhia; and make linen, spirit, bouza, and other articles. The condition of the peasants of Upper Nubia is therefore happy, compared with that of the Fellaheen of Egypt, the most oppressed and degraded population in the world.

The Arabs of the desert have still more reason to be satisfied with the government. They pay tribute only for the land they cultivate, which is in general very little, and in many cases none at all; and otherwise they gain a sufficient livelihood by transporting to Egypt on their camels the grain collected as revenue, or purchased by the government, and by aiding the passage of troops and merchants, which is now unintermitted. As far as regards taxes, and the means of subsistence, therefore, the Arabs of the desert in Upper Nubia, as well as the peasants on the Nile, are in a much better condition than the Fellaheen of Egypt. But in all other respects they are equally galled and insulted by their Turkish rulers. In Egypt, the officers only are oppressive, and the soldiers, who mostly belong to the class of Fellaheen, are not insolent. In Nubia, however, it is far otherwise. The comparatively white complexion of the troops, their character as conquerors, and their pride as *askaria* (soldiers), induce them to despise the natives, and exercise oppressions which the government by no means authorizes. When the chief governor of a province is a man possessed of talent, energy, and firmness of character, the officers and soldiers are prevented from committing many excesses. But when the country has the misfortune to be governed by an individual destitute of the qualities we have mentioned, and too timid to redress the grievances occasioned by the disorderly conduct of the troops, its state may easily be imagined. Every evil is then aggravated by impunity. Men whose ancestors have been meleks or chiefs in the country for ages, are obliged to submit to the insolence and tyranny of a lawless soldiery. Taxes oppressive in themselves are rendered tenfold more so by the mode in which they are levied. Every collection is a species of military execution. No proper notice is almost ever given. "Pay to-morrow, or the bastinado," is the usual intimation conveyed to the peasant, who, not being allowed sufficient time to raise the money, is subjected to this cruel and degrading punishment, and sometimes nailed by the ear to a board. The revolt of the Mahas, described by Mr Hoskins, was occasioned by this summary mode of collecting some arrears of taxes.

General remarks.

Nubia, under proper management, might become a far greater source of wealth to the ruler of Egypt than it now is, or seems likely to be, under his sway. His system is one which is not only calculated to defeat its own objects in a fiscal point of view, but to exasperate the natives, whom good policy would try to conciliate, and also to sow the seeds of future anarchy and convulsion. At the same time, notwithstanding the galling conduct of the Egyptian authorities, the natives are sensible of the advantage of a firm and settled government; and the peasants of the Nile, in particular, are glad to be released from the tyranny and spoliation which accompanied the feuds and petty wars by which the country was formerly distracted. "Did the Turks," says Mr Hoskins, "but treat them as men, and not disgust them by their insulting manners, and by inflicting on them such degrading and infamous punishments; had their rulers but a few ideas of common policy and legislation; the resources [of the country] might be greatly augmented, the revenue increased, and the people the most happy and contented under the sun. The superiority which fire-arms afforded to their haughty conquerors taught them to despise the strength of the Arabs; and, with that insolence which is ever united with ignorance, they do not, in the slightest degree, endeavour to attach them to the government, or, in fact, condescend to treat, otherwise than as a vastly inferior race, the people whom it cost them so much, with all their advantages, to conquer."[1]

Trade.

The chief trade of Nubia, as already mentioned, consists in slaves imported from the interior of Africa, and either conveyed northwards to Egypt, or sent across the Red Sea from Souakin to Jidda. The annual import is estimated at about 5000, of whom 2500 are for Arabia, 1500 for Egypt, and 1000 for Dongola and the Bedouins of the mountains. Few of the slaves are above the age of fifteen; but the most valued are those between eleven and fifteen, who, if males, sell for fifteen or sixteen dollars, and if females, for twenty-five or twenty-six. In the East, slaves are chiefly employed as domestics, and people are seldom fond of any who have not been in the family from an early age. These children, as long as they remain within the negro territories, are treated with great indulgence; but when they once enter the desert, and have no longer any chance of escape, this treatment is entirely changed, and the lash unsparingly applied. The health of the slave, however, is always attended to; he is regularly fed, and receives a share of water with his master. Dates, gums, and ostrich feathers are also exported; as are senna leaves, ebony, sandal-wood,

[1] Hoskins, Travels in Ethiopia, pp. 230, 236.

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and some other articles, though in small quantities. Gold is found in mines, and amongst the river sands, but not in such abundance as to form any considerable article of exchange.

Monumental remains of Nubia.

One of the most remarkable features of this region consists in the magnificent monumental remains with which it is covered along the line of the stream, and which continue to perpetuate the genius and power of the ancient population of the country situated on the Upper Nile. That Egypt was indebted to Ethiopia (which included Nubia) for the rudiments, and perhaps even for the finished patterns, of architectural skill, is no longer questioned by any writer whose pursuits have qualified him to form a judgment of the subject. Gau, in his splendid work on Nubia, maintains it as a first principle, that this country was the cradle of Egyptian architecture; and its monuments embrace the whole period during which the art flourished in the valley of the Lower Nile. He conceives that all the architecture of Egypt, from the first rude effort to cut a temple in the rock, to the construction of those detached edifices which were afterwards erected in the times of the Greeks and Romans, has its types in the structures of Nubia. Hence, in the architectural history of that country, he distinguishes three great epochs; the first comprehending the temples cut in the sides of the hills or rocks, which are evidently the most ancient; the second, those which are detached from the chambers cut in the rock, but still retain the colossal masses of the primitive type; and the third, the small edifices of Maharraga, Gartaas, and Dondour, with several analogous structures in Egypt. This classification appears to be perfectly natural and well founded, inasmuch as the only test of the relative antiquity of such monuments is a reference to the comparative simplicity of their structure or formation. It is upon this principle, therefore, that we shall now proceed to describe very shortly, some of the principal temples and other edifices in Nubia.

Temples of Gibel-el-Birkel, &c.

At Gibel-el-Birkel, Waddington discovered two temples excavated in the solid rock, and having only their exterior chambers formed of masonry; circumstances in which they resemble those of Girshé, Seboua, and Derr. The smaller of the two has six halls or apartments, five of which are cut in the body of the mountain; the larger, constituting the entrance, stands on an artificial foundation of stone, by means of which it is raised as high as the rock in which the other is excavated. Near the adytum there are figures of Ammon and of Horus; and vestiges of hieroglyphics may be discerned in all the chambers. From the plainness of the masonry, the rudeness and decay of the sculptures, and the decomposition of the walls, it has been concluded that this is older than any of the temples of Egypt, or even of Nubia. The temple of Girshé also belongs to the more simple order of structures, and indicates a rude state of the arts connected with architecture. The portico consists of five square columns on each side, cut out of the rock, with a row of circular pillars in front, constructed of several blocks, and originally surmounted with an entablature, though only two of them now remain. Before every one of the square columns stands a colossal statue of sandstone, eighteen feet in height, holding a lash or flail in one hand, and the other hanging down; the figure of each is that of a male, with the pointed beard under the chin, the high sphinx-cap on the head, and the shoulders covered with hieroglyphical inscriptions. On both sides of the portico there is an open alley, which is hewn in the rock. The pronaos, eighteen yards square, is entered from the portico, and contains two rows of immense columns without capitals, in front of each of which there is a colossal figure, more than twenty feet in height, with the hands crossed on the breast, and holding the flagellum in one, and the handled cross, or emblem of life, in the other. On the side walls are four recesses or niches, in each of which are three statues of the natural size, representing the different figures, male and female, which are observed upon the walls of the temples of Egypt. A door leads from the pronaos into the cella, in the middle of which there are two massive pillars, and, upon either side, a small apartment. Very little is now discernible of the sculpture and hieroglyphics with which the walls were covered; but enough remains to show that they were very rudely executed.[1] The ruined structure at Seboua has before it a propylon similar to that of Gourneh at Thebes. The pronaos on each of its longest sides has five columns without capitals, and in front of each is a colossal figure, sixteen feet in height, with the arms crossed on the breast, and the usual emblems in the hands. Before the entrance there lies on the ground a huge statue, the head and bust of which are buried in the sand; and in front of the propylon are two statues, ten feet in height, with their faces towards the river, and attached by the backs to stone pillars of equal elevation. An avenue of sphinxes leads from the bank of the Nile to the temple, but the greater part of them are now buried in the sand, four only remaining visible. The whole fabric appears to be of the remotest antiquity, and has been imitated by the more modern architects of Egypt.[2]

Temple of Ebsamboul.

But of all the rock temples of Nubia, that of Ebsamboul or Ipsamboul,[3] about a day and a half's journey below the second cataract, is incomparably the most remarkable. In the course of centuries the sand of the desert had so completely overwhelmed it, that nothing appeared to the eye of the traveller except the bust of one of the colossal figures which were placed at the front of the entrance. But the dimensions of this statue were so great as to excite the curiosity of all who examined it; and the countenance, when seen at a proper distance, appeared strikingly beautiful. Animated with a desire to explore the buried structure of which this statue formed an exterior ornament, a party, consisting of Mr Belzoni and Captains Irby and Mangles, with some attendants, undertook to remove the sand, so far at least as to ascertain whether there was a door-way, or any other access to the interior. At first they relied upon the assistance of the natives, who readily entered into terms with them; but the increasing fatigue, and an evident disinclination to the work, induced the Nubians to break their engagement, and the travellers had no resource but to complete the labour with their own hands. In the hot season of the year, and with a scanty supply of necessaries, they worked day by day in the sand, from sunrise till night; and at length, after more than three weeks of continued exertion, each performing the labour of about a dozen Nubians, a corner of the door-way became visible; and an entrance having been effected, the interior was explored, probably for the first time during a thousand years.

The first glance at the interior convinced Belzoni and his associates that it was evidently a very large structure; but their astonishment increased when they found it to be one of the most magnificent of temples, enriched with

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1 This is the same place which by other travellers is called Guerfeh Hassan, or Gwersh Hassan, and is described with much minuteness in several of their works. (See Henniker, Notes, &c. p. 154.)

2 The propylon and pronaos are found, on a large scale, at Gourneh, near Thebes; the two statues in advance of the propylon are the miniatures of those in front of the Memnonium; and the sphinxes are seen are Karnak.

3 The name, as spelled by Belzoni, is *Ybsambul*, whilst others write it *Ebsamboul* and *Ibsamboul*. But all these forms are probably corruptions of *Abou-Sambul*, which appears to be the genuine name.

beautiful intaglios, paintings, and colossal figures. The pronaos, fifty-seven feet in length, and fifty in breadth, is supported by two rows of square pillars in a straight line from the front door to that of the sekos; and each pillar has attached to it a figure finely executed, and very little injured by time, the top of the head-dress reaching the ceiling, which is about thirty feet in height. Both the pillars and the walls are covered with representations of battles, storming of castles, triumphs, and sacrifices, in a style, if not superior to, at least bolder than, that of almost any in Egypt, both in regard to the design and the workmanship. The second hall, which is of less dimensions, contains four pillars about four feet square, and the walls are covered with hieroglyphics in tolerable preservation. Beyond this there is a chamber of the same width, but shorter, in which is the entrance to the sanctuary; and at each end is a door leading into smaller apartments in the same direction with the adytum. The sanctuary itself is twenty-three feet in length by twelve in breadth, and contains a pedestal in the centre, with four colossal figures in a sitting posture at the end, all in good order, and uninjured. On the right side of the great hall there are two doors at a short distance from each other, and which lead into two separate apartments of considerable dimensions, at the end of which are several unfinished hieroglyphics, sketched so as to give an idea of the manner of drawing. At the lateral corners of the entrance from the first into the second chamber are doors, each of which leads into a chamber twenty feet by ten; and these again open into other apartments, forty-three feet in length by eleven in breadth. The most remarkable subjects in this temple are a group of captive Ethiopians in the western corner; a hero killing a man with his spear, and another lying dead at his feet; and the storming of a castle, which forms part of the representation. The outside or external front of this temple is truly magnificent, being a hundred and seventeen feet in width, and eighty-six feet in height, whilst the space from the top of the cornice to that of the door is sixty-six feet and a half, and the height of the door itself twenty feet. There are four enormous sitting figures, the largest in Nubia, or even in Egypt, excepting only the great sphinx at the Pyramids, to which they approach in the proportion of nearly two thirds. On the top of the door is a statue of Osiris, twenty feet in height, with a colossal figure on each side looking towards it. The cornice of the temple is adorned with hieroglyphics, and under it are a torus and frize, the one six and the other four feet in breadth. Above the cornice is a row of squatted monkeys, twenty in number, and each eight feet and a half across the shoulders. This temple was nearly two thirds buried in the sand, of which thirty-one feet were removed before reaching the upper part of the door. It is excavated in the solid rock, which here rises about a hundred feet above the Nile, and, excepting one of the tombs at Biban-el-Molouk, is the largest of the kind either in Egypt or Nubia.[1]

At a subsequent period, Mr Bankes visited Ebsamboul, and succeeded in uncovering down to the feet one of the four colossal sitting figures, upon the limbs of which he discovered and copied an inscription in Greek relating to Psammeticus. He next cleared the head of the fourth colossal figure, which had not before emerged above the surface, so as to be able to make a drawing of the whole; and the approach being thus disencumbered, the interior of the temple was lighted up with wax candles fixed on upright poles, to enable Mr Bankes and his assistant draughtsmen to copy all the paintings in detail. It is much to be regretted that the labour in opening this temple has not been attended with any permanent effect; the winds of the desert and the natural lubricity of the sand having soon rendered the approach nearly as difficult as before. In about two years the door-way was again covered up, and by this time the interior must be quite as inaccessible as ever. All travellers agree in the accounts they give of Ebsamboul, which is described as the *ne plus ultra* of Egyptian labour. According to Sir Frederick Henniker, there is no temple at Denderah, Thebes, or Philae, that can be put in comparison with it; and the traveller just named rejoices in "having seen the noblest monument of antiquity that is to be found on the banks of the Nile." This is not the place to enter into details respecting the hieroglyphical emblems and inscriptions with which different parts of this wonderful structure are covered. The larger chamber is distinguished as the temple of Osiris, and the smaller as that of Isis, to whom it is dedicated. The former is represented in a sitting posture, attended by the hawk-headed deity; whilst the latter holds in her hand the lotus-headed sceptre, surrounded with numerous inscriptions and emblems. Much interesting sculpture is also lavished upon the second and third apartments; and in a niche at the upper end of the latter is a small statue of Nephthe, the wife of Typhon, seated. In several places of the square border which encircles the front of the temple, and also on the buttresses between the colossal figures, are a number of ovals or rings, containing the name and prænomen of Ramesses the Great, the same Pharaoh whom the Greeks indicate by the name of Sesostris or Sethosis. We may here add, that a striking resemblance has been observed between the rock temples of India, particularly that in the island of Elephanta, and those of Nubia, especially that of Ebsamboul; indeed the similarity is so great as to have suggested the notion of a common origin, as well in regard to the mythology as the architecture of both countries.[2]

Temples of Samneh, Dondour, &c.

The temple of Samneh, situated on the western bank of the river, between the twenty-first and twenty-second degree of north latitude, affords a specimen of a more perfect class of structures; intermediate, it would seem, between such excavations as that of Ebsamboul and the magnificent edifices of Karnak and Luxor. It is built of sandstone, and differs in shape from other edifices of a similar kind, though in its plan it somewhat resembles the small chapel at Elephantina in Egypt. The principal building is about thirty-six feet in length and nine in breadth. On either hand there stood originally four small pillars, of which two remain on the one side, and three on the other, all covered with sculptures. The inner walls are adorned with hieroglyphics and mystic representations, amongst which may be mentioned the ship of Osiris; and upon the outer wall Burckhardt's distinguished figures of Mendes. The sculptures are rather coarsely executed, and the lines dividing the columns of hieroglyphics, some of which have been left unfinished, are not straight. The temple of Dondour or Tangour is likewise deserving of attention, from the peculiarities of its style, having been classed by Gau amongst those structures which belong to the last of the epochs of Nubian art already mentioned. It is in form a parallelogram, having the proportions observed in some Grecian structures; and in the pillars may be recognised the mixed Greek and Egyptian style. Between the second and third cataract, in latitude twenty-one degrees north, is the temple of Soleb or Solib. An elevated stone foundation extends in front of the temple, and the remains of two sphinxes are seen at either side of the approach. The first

[1] "The heat was so great in the interior of the temple," says Belzoni, "that it scarcely permitted us to take any drawings, as the perspiration from our hands soon rendered the paper quite wet. Accordingly, we left this operation to succeeding travellers, who may set about it with more convenience than we could, as the place will become cooler." (Narrative, p. 214.)

[2] See Erskine's Account of the Cave-Temple of Elephanta, in the Transactions of the Literary Society of Bombay, vol. i. pp. 210, 249.

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chamber is more than a hundred feet in breadth, and about ninety feet in depth, having round three of its sides a single row of pillars, and on the fourth indications of a double row. They have all been executed from the same model, and are inscribed with hieroglyphics. In the second chamber may be traced a row of pillars, resembling those of the first; but they are all broken, and the fragments scattered about in every direction. The dimensions of the adytum cannot now be ascertained, the side walls having been completely destroyed. The temple of Soleb affords the lightest specimen anywhere to be seen of Ethiopian architecture, and, for elegance of proportion, has been compared to that of Minerva Sunias at Cape Colonna. At Gibel-el-Birkel there are the remains of two temples, partly excavated in the rock, and partly constructed, like those of Girshé and Seboua. The principal temple is of vast dimensions, and contains no less than six chambers. It is supposed to have been the work of different and distant periods; and, even in the construction of those parts which belonged to the original building, many stones were employed which had formed parts of some more ancient edifice. The vicinity of Gibel-el-Birkel is remarkable for pyramids, which, though much inferior to those of Egypt, probably originated in the same views of vanity or superstition, not to say tyranny. For further information on the subject of Nubian rock excavations and architecture, the reader is referred to the works of Burckhardt, Light, Legh, Richardson, Henniker, Caillaud, Waddington, and Hoskins, in which will be found ample descriptions of the remains on either side of the Nile, from Assouan to Meroë, accompanied occasionally with drawings and plans. The reader is also referred to the articles Ethiopia, Ethiopian Nations, and Meroe.

General deductions.

On the whole, it appears that, by a more accurate classification of the monuments, and the aid of inscriptions, which to former travellers were altogether unintelligible, we are now enabled to rectify misconceptions, correct mistakes, discard mere conjectures, and, in fact, make a real and valuable addition to the history of civilized Egypt. Between the temples excavated in the rock, such as those of Derr and Ebsamboul, and the buildings of a later date, there was an intermediate stage in the art, which it is important to distinguish. The first architectural attempt in Nubia probably consisted in the improvement of some hole or cave in the rock; or, even if the country possessed no natural caves for imitation by a people possessing the troglodyte habits natural to the inhabitants of a burning climate, the mountains themselves would afford facilities for constructing durable habitations. After having got possession of a hole or cave, the next step of these primitive architects would probably be to extend the excavation, to form several chambers separated by the native rock, and when a compartment of larger dimensions was designed, to have square pillars for the support of the roof. In the course of time the outer front, with the inner walls and pillars, would receive decorations derived from imitations of the natural forms of the country, and subjects connected with the historical remembrances or religious creed of the nation. We see abundant evidence in the rock temples of Nubia to convince us, that the order of progression and improvement here indicated was that actually followed in their gradual enlargement and decoration; yet a prodigious period must have elapsed between the rudest excavation in the rock, such as Derr appears to have been in its primitive state, and the highly-finished sculptures of the great temple of Ebsamboul. In fact, "antiquity appears to have begun" long after these primeval architects had commenced their troglodyte labours. But, in surveying the wonders which crowd the banks of the Nile from Meroë to Memphis, our minds become insensibly impressed with the reflection, that the wealth, power, and genius which produced them have entirely passed away; that, if the new worlds have risen, and new races been discovered, "we have lost old nations;" and that, in the lapse of ages, empires themselves vanish, like the baseless fabric of a vision, leaving scarcely a wreck or trace behind them. Throughout many parts of this extensive tract, a race little superior to savages pass a rude and precarious life, ignorant of the arts which once flourished in their country, and insensible to the beauty and magnificence of the ruins which they desecrate. They have long ceased to claim any connection with the people who constructed the monuments of Ebsamboul, Karnak, Luxor, and Gourneh; and having relapsed into that low condition where curiosity becomes dormant or extinct, they are only moved with wonder when they observe the natives of civilized regions exploring their temples, or taking the dimensions of their obelisks and pyramids. The contrast between what now is, and what once must have been in Ethiopia and in Egypt, is indeed most striking; nor is it easy to pass, even in thought, through the various scenes of conquest and desolation which must have conspired to produce the effects we contemplate. History sheds no light on events and characters which the lapse of three thousand years has covered with impenetrable obscurity; and whilst groping our way amidst temples dedicated to gods, and structures raised in honour of heroes, whose very names sound like voices from the dead, we content ourselves with the conclusion, which all the monuments impress on us, that, long before the dawn of history, there had existed in that singular region a great people, whose architectural monuments have outlasted their learning, their philosophy, and almost even their very name.

(See Buckhardt's *Travels in Nubia;* Waddington's *Journal of a Visit to some parts of Ethiopia;* Richardson's *Travels in the East;* Henniker's *Notes of a Visit to Egypt and Nubia;* Hoskins' *Travels in Ethiopia;* Belzoni's *Narrative of Operations and Discoveries in Egypt and Nubia;* Gau's *Nubia; Life and Adventures of Giovanni Finati;* Russell's *Nubia and Abyssinia;* the work entitled *British Museum;* and Heeren's *Historical Researches.*) (A.)

NUBIAN Desert, a vast tract of barren rocks and burning sands, extending from Syene in Upper Egypt, to Geon, the capital of Berber in Nubia. As Syene is in latitude 24. 0. 45. north, and Geon in latitude 17. 57. 22., the length of this desert from north to south is 6. 3. 23., or upwards of 420 English miles. Its breadth from east to west has not, as far as we know, been precisely ascertained.

NUCKERGAUT, a town of Northern Hindustan, in the province of Serinagur. Long. 78. 5. E. Lat. 30. 3. N.

NUCLEUS, in general, denotes the kernel of a nut, or any seed enclosed within a husk. The term *nucleus* is also used for the body of a comet, otherwise called its *head.*

NUCTA, a dew, which, falling in Egypt about St John's day, is, by the superstitious natives of the country, considered as miraculous, and the peculiar gift of that saint.

NUDDEA, a town of Bengal, and capital of a district of the same name. It is situated on an island at the confluence of the Jelinghy and Cossimbazar Rivers with the Hooghly, sixty miles north from Calcutta. It was the capital of a Hindu principality anterior to the Mogul conquest of Hindustan, and was taken and entirely destroyed in the year 1204. In modern times it has been the seat of a Brahmin seminary of learning; anterior, however, to that in Benares. Long. 88. 24. E. Lat. 23. 25. N. The district is situated between the twenty-second and twenty-fourth degrees of north latitude. It is of a sandy soil, and is considered as the healthiest and driest part of Bengal, though it is not equally productive with some others. It is computed to contain 764,000 inhabitants, about a third of whom are Mahommedans. The principal towns are Kishenagur, Nuddea, and Santipore.

NUESTRA Senhora de Luz, an island in the Pacific h Ocean, discovered by Quiros in 1506. It appears to be the same island which was called Pic de l'Etoile by Bougainville. Lat. 14. 30. S.

NULDINGAH, a town of Hindustan, in the province of Bengal, seventy-four miles north east by north from Calcutta. Long. 89. 7. E. Lat. 23. 25. N.

NUJENGODE, a town of Hindustan, in the province of Mysore, which stands on the south bank of the Cubany River, and is inhabited by Brahmins, who derive their support from a celebrated pagoda or temple, to which immense numbers of Hindus resort. Long. 76. 50. E. Lat. 12. 1. N.

NUMA Pompilius, the fourth son of Pompilius Pompo, an illustrious Sabine. Having married Tatia, the daughter of King Tatius, he remained with her in his native country, preferring the tranquillity of a private life to the splendour of a court. Upon the death of his wife, with whom he had lived thirteen years, he gave himself up entirely to the study of wisdom; and, leaving the city of Cures, confined himself to the country, wandering from solitude to solitude, in search only of those woods and fountains which religion had consecrated. His recluse life gave rise to the fable, which was very early received amongst the Sabines, that Numa lived in familiarity with the nymph Egeria. Upon the death of Romulus, both the senate and people strongly solicited him to become their king. They despatched Julius Proculus and Valerius Volesus, two senators of distinction, to acquaint Numa with their resolution, and make him an offer of the kingdom. The Sabine philosopher at first rejected their proposal; but being at last prevailed upon by the arguments and entreaties of the deputies, joined with those of his father, and of Martius his near relation, he at length yielded, and having offered sacrifices to the gods, set out for Rome, where he was received by all ranks of people with loud shouts of joy.

After a reign of forty-two years, during which he had given every possible encouragement to the useful arts, and in which he had cultivated peace, Numa died in the year of Rome 82. Not only the Romans, but also the neighbouring nations, were eager to pay respect to the memory of a monarch whom they revered for his abilities, moderation, and humanity. He forbade his body to be burned, according to the custom of the Romans, and ordered it to be buried near Mount Janiculum, along with many of the books which he had written. These books were accidentally found by one of the Romans, about four hundred years after his death; and as they contained nothing new or interesting, but merely the reasons why he had made innovations in the form of worship and in the religion of the Romans, they were burned by order of the senate.

NUMANTIA, a very noble city, the ornament of the Hither Spain, and celebrated for the long war of twenty years which it maintained against the Romans. The baseness and injustice of the Romans during this war were truly disgraceful to them, and altogether unworthy of a great and powerful people. The inhabitants obtained some advantages over the Roman forces, till Scipio Africanus was empowered to finish the war, and to effect the destruction of Numantia. He began the siege with an army of sixty thousand men, and was bravely opposed by the besieged, who were no more than four thousand men able to bear arms. Both armies behaved with uncommon valour, and the courage of the Numantines was soon changed into the fury of despair. Their provisions began to fail, and they fed upon the flesh of their horses, and afterwards upon that of their dead companions; but at last they were obliged to draw lots to kill and devour one another. The melancholy situation of their affairs obliged them to surrender to the Roman general. Scipio required them to deliver themselves up on the morrow; but they refused, and when a longer time had been granted to their petitions, they retired, and having set fire to their houses, destroyed themselves, so that not even one remained to adorn the triumph of the conqueror. Some historians, however, deny this, asserting that a number of Numantines delivered themselves into Scipio's hands, and that fifty of them were drawn in triumph at Rome, the rest being sold as slaves. The fall of Numantia was more glorious than that of Carthage or Corinth, though the place was much inferior to either. It was taken by the Romans 629 A. U. C.; and the conqueror obtained the surname of *Numanticus*.

Number.

NUMBER, an assemblage of several units, or things of the same kind. Number is either abstract or applicate; abstract, when referred to things in general, without attending to their particular properties; and applicate, when considered as the number of a particular sort of things, as yards, trees, or the like. When particular things are mentioned, there is always something more considered than barely their numbers; so that what is true of numbers in the abstract, or when nothing but the number of things is considered, will not be true when the question is limited to particular things. For instance, the number two is less than three, yet two yards is a greater quantity than three inches; and the reason is, because regard must be had to their different natures as well as number, whenever things of a different species are considered; for although we can compare the number of such things abstractedly, yet we cannot compare them in any applicate sense. And this difference is necessary to be considered, because upon it the true sense, and the possibility or impossibility, of some questions depend. Number is unlimited in respect of increase; because we can never conceive a number so great but there is still a greater. However, in respect of decrease, it is limited; unity being the first and least number, below which, therefore, it cannot descend.

Mathematicians, considering number under a great many relations, have established the following distinctions. Broken numbers are the same with fractions. Cardinal numbers are those which express the quantity of units, as 1, 2, 3, 4, &c.; whereas ordinal numbers are those which express order, as 1st, 2d, 3d, &c. Compound number is one divisible by some other number besides unity; as 12, which is divisible by 2, 3, 4, and 6. Numbers, as 12 and 15, which have some common measure besides unity, are said to be compound numbers amongst themselves. Cubic number is the product of a square number by its root; as 27, which is the product of the square number 9 by its root 3. All cubic numbers, the root of which is less than 6, being divided by 6, the remainder is the root itself. Thus $27 \div 6$ leaves the remainder 3, its root; 216, the cube of 6, being divided by 6, leaves no remainder; 343, the cube of 7, leaves a remainder 1, which, added to 6, is the cube root: and 512, the cube of 8, divided by 6, leaves a remainder 2, which, added to 6, is the cube root. Hence the remainders of the divisions of the cubes above 216, divided by 6, being added to 6, always give the root of the cube so divided till that remainder be 5, and consequently 11, the cube root of the number divided. But the cubic numbers above this being divided by 6, there remains nothing, the cube root being 12. Thus the remainders of the higher cubes are to be added to 12, and not to 6, till you come to 18, when the remainder of the division must be added to 18; and so on *in infinitum*. Determinate number is that referred to some given unit, as a ternary or three; whereas an indeterminate one is that referred to unity in general, and is called *quantity*. Homogeneal numbers are those referred to the same unit; as those referred to different units are termed *heterogeneal*. Whole numbers are otherwise called *integers*. Rational number is one commensurable with unity; as a number incommensurable with unity is termed *irrational*, or a *surd*. In the same manner, a rational whole number is that of

Number.

which unity is an aliquot part; a rational broken number, that equal to some aliquot part of unity; and a rational mixed number, that consisting of a whole number and a broken one. Even number is that which may be divided into two equal parts without any fraction, as 6, 12, &c. The sum, difference, and product, of any number of even numbers, is always an even number. An evenly even number is that which may be measured, or divided, without any remainder, by another even number, as 4 by 2; an unevenly even number, when a number may be equally divided by an uneven number, as 20 by 5; uneven number, that which exceeds an even number, at least by unity, or which cannot be divided into two equal parts, as 3, 5, &c. The sum or difference of two uneven numbers makes an even number; but the factum of two uneven ones makes an uneven number. If an even number be added to an uneven one, or if the one be subtracted from the other, in the former case the sum, in the latter the difference, is an uneven number; but the factum of an even and uneven number is even. The sum of any even number of uneven numbers is an even number; and the sum of any uneven number of uneven numbers is an uneven number.

Primitive or prime numbers are those divisible only by unity, as 5, 7, &c.; and prime numbers amongst themselves are those which have no common measure besides unity, as 12 and 19. Perfect number is that the aliquot parts of which added together make the whole number, as 6, 28; the aliquot parts of 6 being 3, 2, and 1, = 6; and those of 28, being 14, 7, 4, 2, 1, = 28. Imperfect numbers are those the aliquot parts of which added together make either more or less than the whole, and these are distinguished into abundant and defective. An instance in the former case is 12, the aliquot parts of which, 6, 4, 3, 2, 1, make 16; and in the latter case 16, the aliquot parts of which 8, 4, 2, and 1, make but 15. Plane number is that arising from the multiplication of two numbers, as 6, which is the product of 3 by 2; and these numbers are called the *sides of the plane*. Square number is the product of any number multiplied by itself; thus 4, which is the factum of 2 by 2, is a square number. An even square number added to its root makes an even number.

Figurate numbers are such as represent some geometrical figure, in relation to which they are always considered; as triangular, pentagonal, and pyramidal numbers. Figurate numbers are distinguished into orders, according to their place in the scale of their generation, being all produced one from another, viz. by adding continually the terms of any one, the successive sums are the terms of the next order, beginning from the first order, which is that of equal units, 1, 1, 1, 1, &c.; then the second order consists of the successive sums of those of the first order, forming the arithmetical progression 1, 2, 3, 4, &c.; those of the third order are the successive sums of those of the second, and are the triangular numbers 1, 3, 6, 10, 15, &c.; those of the fourth order are the successive sums of those of the third, and are the pyramidal numbers 1, 4, 10, 20, 35, &c.; and so on, as below:

Order.	Names.	Numbers.
1.	Equals,	1, 1, 1, 1, 1, &c.
2.	Arithmeticals,	1, 2, 3, 4, 5, &c.
3.	Triangulars,	1, 3, 6, 10, 15, &c.
4.	Pyramidals,	1, 4, 10, 20, 35, &c.
5.	Second Pyramidals,	1, 5, 15, 35, 70, &c.
6.	Third Pyramidals,	1, 6, 21, 56, 126, &c.
7.	Fourth Pyramidals,	1, 7, 28, 84, 210, &c.

The above are all considered as different sorts of triangular numbers, being formed from an arithmetical progression the common difference of which is 1. But if that common difference be 2, the successive sums will be the series of square numbers; if it be 3, the series will be pentagonal numbers, or pentagons; if it be 4, the series will be hexagonal numbers, or hexagons; and so on. Thus:

Arithmeticals.	First Sums, or Polygons.	Second Sums, or Second Polygons.
1, 2, 3, 4	Tri. 1, 3, 6, 10	1, 4, 10, 20
1, 3, 5, 7	Sqrs. 1, 4, 9, 16	1, 5, 14, 30
1, 4, 7, 10	Pent. 1, 5, 12, 22	1, 6, 18, 40
1, 5, 9, 13	Hex. 1, 6, 15, 28	1, 7, 22, 50
&c.		

The reason of the names, triangles, squares, pentagons, hexagons, and the like, is, that those numbers may be placed in the form of these regular figures or polygons. But the figurate numbers of any order may also be found without computing those of the preceding orders; which is done by taking the successive products of as many of the terms of the arithmeticals, 1, 2, 3, 4, 5, &c. in their natural order, as there are units in the number which denominates the order of figurates required, and dividing these products always by the first product. Thus the triangular numbers are found by dividing the products 1×2, 2×3, 3×4, 4×5, &c. each by the first product 1×2; the first pyramids by dividing the products $1 \times 2 \times 3$, $2 \times 3 \times 4$, $3 \times 4 \times 5$, &c. by the first $1 \times 2 \times 3$. And, in general, the figurate numbers of any order n, are found by substituting successively 1, 2, 3, 4, 5, &c. instead of x in this general expression $\frac{x \cdot x+1 \cdot x+2 \cdot x+3 \cdot \&c.}{1 \cdot \; 2 \; \cdot \; 3 \; \cdot \; 4 \; \cdot \&c.}$; where the factors in the numerator and denominator are supposed to be multiplied together, and to be continued till the number in each be less by 1 than that which expresses the order of the figurates required.[1]

Polygonal or polygonous numbers are the sums of arithmetical progressions beginning with unity, and these, where the common difference is 1, are called *triangular numbers*; where it is 2, *square numbers*; where it is 3, *pentagonal numbers*; where it is 4, *hexagonal numbers*; where it is 5, *heptagonal numbers*, &c. Pyramidal numbers, the sums of polygonous numbers, collected after the same manner as the polygons themselves, and not gathered out of arithmetical progressions, are called *first pyramidal numbers*; and the sums of the first pyramidals are called *second pyramidals*, &c. If they arise out of triangular numbers, they are called *triangular pyramidal numbers*; and if out of pentagons, *first pentagonal pyramidals*. From the manner of summing up polygonal numbers, it is easy to conceive how the prime pyramidal numbers are found. The formula $\frac{(a-2)\,n^3 + 3\,n^3 - (a-5)\,n}{6}$ expresses all the prime pyramidals.

The number 9 has a very curious property, its products always composing either 9 or some lesser product thereof. If our limits permitted us, we could instance in a variety of other numbers properties both curious and surprising. Such speculations are indeed by some men considered as trifling and useless. But perhaps they judge too hastily; for few employments are more innocent, none more ingenious, nor, to those who have a taste for them, more amusing.

Numbers were by the Jews, as well as the ancient Greeks

[1] See Maclaurin's Fluxions, art. 351, in the notes; also Simpson's Algebra, p. 213; or Malcolm's Arithmetic, p. 396, where the subject of figurates is treated in a very extensive and perspicuous manner. Hutton's Mathematical Dictionary may also be consulted.

and Romans, expressed by means of letters of the alphabet. Hence we may conceive how imperfect and limited their arithmetic was; because the letters could not be arranged in a series, or in different lines, conveniently enough for the purposes of ready calculation. The invention of the ciphers, or arithmetical figures, which we now make use of, has given us in this respect a very great advantage over the ancients; to say nothing of that which is derived from these figures having a value in position. See ARITHMETIC.

The letters chiefly employed by the Romans to express numbers were, M for 1000, D for 500, C for 100, L for 50, V for 5, X for 10, and I for one. M probably signifies 1000, because it is the initial of *mille;* D stands for 500, because it is *dimidium mille;* C signifies 100, as being the first letter of the word *centum;* L stands for 50, because it is the half of C, having formerly been written thus, L; V signifies 5, because V is the half of X, which stands for 10; I stands for one, because it is the first letter of *initium.* These, however, are fanciful derivations, and an explanation more accordant with philosophical principles has been given in the article ARITHMETIC. See also NUMERAL LETTERS.

The Jewish cabbalists, the Grecian conjurors, and the Roman augurs, had a great veneration for particular numbers, and the result of particular combinations of numbers. Thus three, four, six, seven, nine, ten, were full of divine mysteries, and of great efficacy.

NUMBERS, in *Poetry* and *Oratory*, are certain measures, proportions, or cadences, which render a verse, period, or song agreeable to the ear.

Poetical numbers consist in a certain harmony in the order, quantities, and adjustment of the feet and syllables which render the piece musical to the ear, and capable of being sung, for which all the verses of the ancients were intended. It is of these numbers Virgil speaks in his ninth Eclogue, when he makes Lycidas say, *Numeros memini, si verba tenerem;* meaning, that although he had forgotten the words of the verses, yet he remembered the feet and measure of which they were composed.

Rhetorical or prosaic numbers are a sort of simple unaffected harmony, less glaring than that of verse, but such as is perceived and affects the mind with pleasure.

Book of NUMBERS, the fourth book of the Pentateuch, taking its denomination from the numbering of the families of Israel. A part of this book is historical, relating to several remarkable passages in the march of the Israelites through the wilderness. It contains a distinct relation of their several movements from one place to another, or their forty-two stages through the wilderness, and many other things, by which we are instructed and confirmed in some of the most weighty truths which have immediate reference to God and his providence in the world. But the greater part of this book is occupied in enumerating those laws and ordinances, whether civil or ceremonial, which were given by God, but not mentioned before in the preceding books.

NUMERAL LETTERS are those letters of the alphabet which are generally used for figures, as I, one; V, five; X, ten; L, fifty; C, a hundred; D, five hundred; M, a thousand; and so on. It is not agreed how the Roman numerals originally received their value. It has been supposed, as we have observed in the article NUMBER, that the Romans used M to denote 1000, because it is the first letter of *mille,* which is the Latin word for 1000; and C to denote 100, because it is the first letter of *centum,* which in Latin means 100. It has also been supposed that D, being formed by dividing the old M in the middle, was therefore appointed to stand for 500, that is, half as much as the M stood for when it was whole; and that L being half a C, originally written ⊏, was for the same reason used to denominate fifty. But what reason is there to suppose that 1000 and 100 were the numbers which letters were first used to express? And what reason can be assigned why D, the first letter in the Latin word *decem,* ten, should not rather have been chosen to stand for that number than for 500, because it had a rude resemblance to half an M? But if these questions could be satisfactorily answered, there are other numeral letters which have never yet been accounted for at all. These considerations render it probable that the Romans did not, in their original intention, employ letters to express numbers at all. The most natural account of the matter seems to be this: The Romans probably put down a single stroke, I, for one, as is still the practice of those who score upon a slate or with chalk. This stroke, I, they doubled, trebled, and quadrupled, to express 2, 3, and 4; thus, II., III., IIII. So far they could easily number the strokes with a glance of the eye. But they presently found that if more were added it would soon be necessary to tell the strokes one by one. For this reason, then, when they came to 5, they expressed it by joining two strokes together in an acute angle, thus, V; which will appear the more probable, if it be considered that the progression of the Roman numbers is from 5 to 5, that is, from the fingers on one hand to the fingers on the other. Ovid has touched upon the original of this in his *Fasti* (lib. iii.), and Vitruvius has made a similar remark.

After they had made this acute angle V for five, they added the single strokes to it to the number of four, thus VI., VII., VIII., VIIII., and then, as the strokes could not be further multiplied without confusion, they doubled their acute angle by prolonging the two lines beyond their intersection, thus, X, to denote two fives, or ten. After this they doubled, trebled, and quadrupled this double acute angle thus, XX., XXX., XXXX.; they then, for the same reason which induced them first to make a single and then to double it, joined two single strokes in another form, and instead of an acute angle, made a right angle, L, to denote fifty. When this fifty was doubled, they then doubled the right angle thus, E, to denote 100; and having numbered this double right angle four times, thus, ⊏⊏, ⊏⊏⊏, ⊏⊏⊏⊏, when they came to the fifth number, as before, they reverted it, and put a single stroke before it thus I⊐, to denote 500; and when this 500 was doubled, then they also doubled their double right angle, setting two double right angles opposite to each other, with a single stroke between them, thus, ⊏I⊐, to denote 1000. When this note for 1000 had been four times repeated, then they put down I⊐⊐ for 5000, ⊏⊏I⊐⊐ for 10,000, and I⊐⊐⊐ for 50,000, and ⊏⊏⊏I⊐⊐⊐ for 100,000, I⊐⊐⊐⊐ for 500,000, and ⊏⊏⊏⊏I⊐⊐⊐⊐ for one million.

That the Romans did not originally write M for 1000, and C for 100, but square characters, as they are represented above, we are expressly informed by Paulus Manutius; but the corners of the angles being cut off by the transcribers for despatch, these figures were gradually brought into what are now numeral letters. When the corners of ⊏I⊐ were made round, it stood thus CIↃ, which is so near the Gothic *m*, that it soon deviated into that letter; so I⊐ having the corners rounded, stood thus, IↃ, and then easily deviated into D. L also became a plain C by the same means; the single rectangle which denoted fifty was, without alteration, a capital L; the double acute angle was an X; the single acute angle a V consonant; and a plain single stroke the letter I; and thus these seven letters, M, D, C, L, X, V, I, became numerals.

NUMERAL *Characters* of the Arabs are those figures which are now used in all the operations of arithmetic in every nation in Europe. See the article ARITHMETIC.

NUMERATION, or NOTATION, in *Arithmetic*, the art of expressing in characters any number proposed in words, or of expressing in words any number proposed in characters. See ARITHMETIC.

NUMERICAL, Numerous, or *Numeral*, something relating to numbers; thus Numerical Algebra is that which makes use of numbers instead of letters of the alphabet. Numerical difference is also that by which one man is distinguished from another. Hence a thing is said to be numerically the same, when it is so in the strictest sense of the word.

NUMIDIA, an ancient kingdom of Africa, bounded on the north by the Mediterranean Sea; on the south by Gætulia, or part of Libya Interior; on the west by the Mulucha, a river which separated it from Mauritania; and on the east by the Tusca, another river which formed its conterminous boundary with Africa Propria.

This country included two divisions, one inhabited by the *Massyli*, and the other by the *Massæsyli;* the country of the latter being also called in after times *Mauritania Cæsariensis*, and that of the former *Numidia Propria.* The country of the Massyli, or, as some call it, *Terra Metagonitis*, was separated from the territory of Carthage by its eastern boundary the river Tusca, and from the kingdom of the Massæsyli, or Mauritania Cæsariensis, by the river Ampsaga; and it seems to have corresponded with that part of the province of Constantina lying between the Zaine and the Wed al Kebeer, which is above 130 miles in length, and more than 100 in breadth. The sea-coast of this province is for the most part mountainous and rocky, answering to the appellation given to it by Abulfeda, who calls it *El Edwaa*, the high or lofty. It is far from being equal in extent to the ancient country of the Massæsyli, which, however, Strabo informs us, was inferior to the country of the Massyli. Its capital was Cirta, a place of very considerable note amongst the ancients.

Several learned writers have supposed that the tract extending from the isthmus of Suez to the lake Tritonis was chiefly peopled by the descendants of Mizraim, and that the posterity of his brother Put, or Phut, spread themselves all over the country between that lake and the Atlantic Ocean. And to this notion Herodotus gives some countenance; for he tells us that the Libyan Nomades, whose territories to the west were bounded by the Triton, agreed in their customs and manners with the Egyptians; but that the Africans, from that river to the Atlantic Ocean, differed from them in almost all points. Ptolemy mentions a city called *Putea*, near Adrametum, and Pliny a river of Mauritania Tingitana, known by the name of *Fut*, or *Phut;* and the district adjacent to this river was called *Regio Phutensis*, which plainly involves in it the name of *Phut.* That word signifies scattered or dispersed; and this agrees very well with what Mela and Strabo relate of the ancient Numidians; so that we may, without any scruple, admit the aborigines of this country to have been the descendants of Phut.

The history of Numidia, during many of the early ages, is buried in oblivion. It is probable, however, that as the Phœnicians were masters of a great part of the country, their transactions had been recorded, and were generally known to the Carthaginians. King Jarbas probably reigned here as well as in Africa Propria, if not in Mauritania and other parts of Libya, when Dido began to build Byrsa. It appears from Justin, that about the age of Herodotus the people of this country were called both Africans or Libyans, and Numidians. Justin likewise intimates, that about this time the Carthaginians vanquished both the Moors or Mauritanians and the Numidians; in consequence of which they were excused from paying the tribute which had hitherto been demanded of them.

After the conclusion of the first Punic war, the African troops carried on a sanguinary contest against their masters the Carthaginians; and the most active in this rebellion, according to Diodorus Siculus, were a part of the Numidian nation named Micatanians. This so incensed the Carthaginians, that after Hamilcar had either killed or taken prisoners all the mercenaries, he sent a large detachment to ravage the country of those Numidians; and the commandant of that detachment executed his orders with the utmost cruelty, plundering the district in a terrible manner, and crucifying, without distinction, all the prisoners who fell into his hands. This filled the rest with such indignation and resentment, that both they and their posterity ever afterwards cherished an implacable hatred to the Carthaginians.

In the time of the second Punic war, Syphax, king of the Massæsyli, having entered into an alliance with the Romans, gave the Carthaginians a considerable defeat. This induced Gala, king of the Massyli, to conclude a treaty with the Carthaginians, in consequence of which his son Masinissa marched at the head of a powerful army to give Syphax battle. The contest ended in favour of Masinissa; thirty thousand of the Massæsyli were put to the sword, and Syphax driven into Mauritania; and a similar reverse attended Syphax in another engagement, where his troops were entirely defeated and dispersed.

Gala having died whilst his son Masinissa was acting at the head of the Numidian troops sent to the assistance of the Carthaginians in Spain, his brother Desalces, according to the established rules of succession in Numidia, took possession of the Massylian throne. That prince, however, died soon after his succession, and Capusa his eldest son succeeded him. But he did not long enjoy his high dignity; for one Mezetulus, a person of the royal blood, but an enemy to the family of Gala, found means to excite a great part of his subjects to revolt. A battle soon took place between him and Capusa, in which the latter was slain with many of the nobility, and his army entirely defeated. But though Mezetulus thus became possessed of the sovereignty, he did not think proper to assume the title of king, and only styled himself guardian to Lacumaces, the surviving son of Desalces, whom he graced with the royal title. To support himself in his usurpation, he married the widow of Desalces, who was Hannibal's niece, and consequently of the most powerful family in Carthage; and in order to attain the same end, he sent ambassadors to Syphax, to conclude a treaty of alliance with him. In the mean time, Masinissa, having received advice of his uncle's death, of his cousin's slaughter, and of Mezetulus's usurpation, immediately passed over to Africa, and went to the court of Bocchar king of Mauritania to solicit succours. Bocchar, sensible of the great injustice which had been done Masinissa, gave him a body of four thousand Moors to escort him to his dominions; and his subjects, being apprised of his approach, joined him upon the frontiers with a party of five hundred men. The Moors, in pursuance of their orders, returned home as soon as Masinissa reached the confines of his kingdom; notwithstanding which, and the small body that declared for him, having accidentally met Lacumaces at Thapsus, with an escort, going to implore the assistance of Syphax, he drove him into the town, which he carried by assault after a faint resistance. Lacumaces, however, with many of his men, found means to escape to Syphax. The fame of this exploit gained Masinissa great credit, insomuch that the Numidians flocked to him from all parts, and amongst the rest many of his father Gala's veterans, who pressed him to make a speedy and vigorous effort to recover his hereditary dominions. Lacumaces having joined Mezetulus with a reinforcement of Massæsylians, which he had prevailed upon Syphax to send to the assistance of his ally, the usurper advanced at the head of a numerous army to offer Masinissa battle, which that prince, although much inferior in numbers, did not decline. An engagement accordingly ensued, and, notwithstanding the inequality of numbers, it ended in the defeat of Lacumaces. The immediate consequence of this victory of Masinissa was the quiet and peaceable possession of his kingdom; Mezetulus and Lacumaces, with a few that attended them, having fled into the territories of Carthage. However, being apprehensive that he should be obliged to sustain a war against Syphax, he offered to treat Lacumaces with as many marks of distinction as his father Gala had Desalces, provided that prince would put himself under his protection. He also promised Mezetulus pardon, and the restitution of all the property forfeited by his treasonable conduct, if he would make his submission to him. Both of them readily complied with the proposal, and immediately returned home; so that the tranquillity and repose of Numidia would have been settled upon a solid and lasting foundation, had not this been prevented by Asdrubal, who was then at the court of Syphax. He insinuated to that prince, who was disposed to live amicably with his neighbours, "that he was greatly mistaken if he imagined Masinissa would be satisfied with his hereditary dominions; that he was a prince of much greater capacity and ambition than either his father Gala, his uncle Desalces, or any of his family; that he had discovered in Spain marks of rare and uncommon merit; and that, in fine, unless this rising flame was extinguished before it came to too great a head, both the Massæsylian and Carthaginian states would infallibly be consumed by it." Syphax, alarmed by these suggestions, advanced with a numerous body of forces into a district which had long been a subject of dispute between him and Gala, but was then in possession of Masinissa. This brought on a general action between these two princes, wherein the latter was totally defeated, his army dispersed, and he himself obliged to fly to the top of Mount Balbus, attended by only a few of his horse. Such a decisive battle, before Masinissa had been firmly seated on his throne, could not fail to put Syphax into possession of the kingdom of the Massyli. Masinissa, in the mean time, made nocturnal incursions from his post upon Mount Balbus, and plundered all the adjacent country, particularly that part of the Carthaginian territory contiguous to Numidia. This district he not only thoroughly pillaged, but likewise laid waste with fire and sword, carrying off from thence an immense booty, which was purchased of him by some merchants, who had put into one of the Carthaginian ports for that purpose. In fine, he did the Carthaginians more damage, not only by committing such dreadful devastations, but by massacring and carrying into captivity vast numbers of their subjects on this occasion, than they could have sustained in a pitched battle, or a whole campaign of a regular war. Syphax, at the pressing and reiterated instances of the Carthaginians, sent Bocchar, one of his most active commanders, with a detachment of four thousand foot and two thousand horse, to reduce this pestilent gang of robbers; promising him a great reward if he would bring Masinissa either alive or dead. Bocchar, having watched an opportunity, surprised the Massylians as they were straggling about the country without any order or discipline; so that he took many prisoners, dispersed the rest, and pursued Masinissa himself, with a few of his men, to the top of the mountain where he had before taken post. Considering the expedition as ended, he not only sent many head of cattle, and the other booty that had fallen into his hands, to Syphax, but likewise all the force, except five hundred foot and two hundred horse. With this detachment he drove Masinissa from the summit of the hill, and pursued him through several narrow passes and defiles as far as the plains of Clupea, where he so completely surrounded him, that all the Massylians except four were put to the sword, and Masinissa himself, after having received a dangerous wound, escaped with the utmost difficulty. As this was effected by crossing a rapid river, in which attempt two of his four attendants perished in the sight of the detachment that pursued him, it was rumoured all over Africa that Masinissa also was drowned; news which gave inexpressible pleasure to Syphax and the Carthaginians. For some time he lived undiscovered in a cave, where he was supported by the robberies of the two horsemen who had made their escape with him. But having cured his wound by the application of some medicinal herbs, he began to advance boldly towards his own frontiers, giving out publicly that he intended once more to take possession of his kingdom. In his march he was joined by about forty horse, and, soon after his arrival amongst the Massyli, so many people flocked to him from all parts, that out of them he formed an army of six thousand foot and four thousand horse. At the head of these forces he not only reinstated himself in possession of his dominions, but likewise laid waste the borders of the Massæsyli. This so irritated Syphax, that he immediately assembled a numerous body of troops, and encamped very commodiously upon a ridge of mountains between Cirta and Hippo. His army he commanded in person, and detached his son Vermina, with a considerable force, to make a detour, and attack the enemy in the rear. In pursuance of his orders, Vermina set out in the beginning of the night, and took post in the place appointed, without having been discovered by the enemy. In the mean time Syphax decamped, and advanced towards the Massyli, in order to give them battle. When he had possessed himself of a rising ground which led to their camp, and concluded that his son Vermina must have formed the ambuscade behind them, he began the fight. Masinissa being advantageously posted, and his soldiers distinguishing themselves in an extraordinary manner, the dispute proved long and bloody. But Vermina having unexpectedly fallen upon their rear, and by this means obliged them to divide their forces, which were scarcely able before to oppose the main body under Syphax, they were soon thrown into confusion, and forced to betake themselves to a precipitate flight. All the avenues being blocked up, partly by Syphax, and partly by his son, such a dreadful slaughter was made of the unhappy Massylians, that only Masinissa himself, and sixty horse, escaped to the Lesser Syrtis. Here he remained, between the confines of the Carthaginians and the Garamantes, till the arrival of Lælius and the Roman fleet on the coast of Africa.

By the assistance of Lælius, Masinissa at last reduced Syphax's kingdom. According to Zonaras, Masinissa and Scipio, before the memorable battle of Zama, deprived Hannibal, by a stratagem, of some advantageous posts; which, with a solar eclipse that happened during the heat of the action, and not a little intimidated the Carthaginian troops, greatly contributed to the victory obtained by the Romans. At the conclusion, therefore, of the second Punic war, he was amply rewarded by the Romans for the important services he had rendered them. As for Syphax, after the loss of his dominions, he was kept in confinement for some time at Alba; but being removed thence in order to grace Scipio's triumph, he died at Tibur, in his way to Rome. Zonaras adds, that his corpse was decently interred; that all the Numidian prisoners were released; and that Vermina, by the assistance of the Romans, took peaceable possession of his father's throne. However, part of the Massæsylian kingdom had before been annexed to Masinissa's dominions, in order to reward that prince for his singular fidelity and firm attachment to the Romans.

Nothing further is requisite to complete the history of this famous prince, than to exhibit some points of his conduct towards the decline and at the close of life; the wise dispositions made after his death by Æmilianus for the regulation of his domestic affairs; and some particulars relating to his character, genius, and habit of body, drawn from the most celebrated Greek and Roman authors.

By drawing a line of circumvallation around the Cartha-

Numidia. ginian army under Asdrubal, posted upon an eminence, Masinissa cut off all manner of supplies, and thus introduced both the plague and famine into their camp. As the body of Numidian troops employed in this blockade was not nearly so numerous as the Carthaginian forces, it is evident, that the line here mentioned must have been extremely strong, and consequently the effect of great labour and art. The Carthaginians, finding themselves reduced to the last extremity, concluded a peace upon the terms which Masinissa himself dictated to them, viz. That they should deliver up all deserters; that they should recall their exiles, who had taken refuge in his dominions; that they should pay him five thousand talents of silver within the space of fifty years; and that their soldiers should pass under the yoke, each of them carrying off only a single garment. As Masinissa himself, though between eighty and ninety years of age, conducted the whole enterprise, he must have been extremely well versed in fortification, and other branches of the military art; and he must likewise have retained his understanding to the last. This happened a short time before the commencement of the third Punic war.

Soon afterwards, the consuls landed an army in Africa, in order to lay siege to Carthage, without imparting their design to Masinissa. This not a little chagrined him, as it was contrary to the former practice of the Romans, who, in the preceding war, had communicated their intentions to him, and consulted him on all occasions. When, therefore, the consuls applied to him for a body of his troops to act in concert with their forces, he answered, "That they should have a reinforcement from him when they stood in need of it." The reflection, that after he had extremely weakened the Carthaginians, and even brought them to the brink of ruin, his pretended friends should come to reap the fruits of his victory, without giving him the least intelligence of their design, must have been sufficiently galling to an old and faithful ally, who had done and suffered so much in their cause.

However, his mind soon returned to its natural bias, which was in favour of the Romans. Finding his end approaching, he sent to Æmilianus, then a tribune in the Roman army, to desire a visit from him. What he proposed by this visit, was to invest him with full powers to dispose of his kingdom and estate as he should think proper, for the benefit of his children. The high idea he had entertained of that young hero's abilities and integrity, together with his gratitude and affection for the family into which he was adopted, induced him to take this step. But believing that death would not permit him to have a personal conference with Æmilianus upon this subject, he informed his wife and children, in his last moments, that he had empowered him to dispose, in an absolute manner, of all his possessions, and divide his kingdom amongst his sons; to which he subjoined, "I require, that whatever Æmilianus may decree, shall be executed as punctually as if I myself had appointed it by my will." Having uttered these words, he expired, at a very advanced age.

Masinissa, before his death, gave his ring to his eldest son Micipsa, but left the distribution of all his other effects and possessions amongst his children entirely to Æmilianus. Of fifty-four sons who survived him, only three were legitimate, to wit, Micipsa, Gulussa, and Mastanabal. Æmilianus arrived at Cirta after he had expired, and divided his kingdom, or rather the government of it, amongst these three, though to the others he gave considerable possessions. To Micipsa, who was a prince of a pacific disposition, and the eldest son, he assigned Cirta, the metropolis, for the place of his residence, in exclusion of the others. Gulussa, the next to him, being a prince of military genius, had the command of the army, and the transacting of all affairs relating to peace or war, committed to his care. And Mastanabal, the youngest, had allotted him the administration of justice, an employment suitable to his education. They enjoyed in common the immense treasures Masinissa had amassed, and were all of them dignified by Æmilianus with the royal title. After he had made these various dispositions, he departed from Cirta, taking with him a body of Numidian troops, under the conduct of Gulussa, to reinforce the Roman army which was then acting against the Carthaginians.

Mastanabal and Gulussa died soon after their father, as appears from the express testimony of Sallust; and we find nothing remarkable of these princes, besides what has been already related, except that the latter continued to assist the Romans in the third Punic war, and that the former was pretty well versed in the Greek language. Micipsa, therefore, became sole possessor of the kingdom of Numidia. In his reign, and under the consulate of M. Platius Hypsæus and M. Fulvius Flaccus, according to Orosius, a great part of Africa was covered with locusts, which destroyed all the produce of the earth, and even devoured dry wood. But at last they were all carried by the wind into the African Sea, out of which being thrown in vast heaps upon the shore, a plague ensued, which swept away an infinite number of animals of all kinds. In Numidia alone eight hundred thousand men perished, and in Africa Propria two hundred thousand, including thirty thousand Roman soldiers quartered in and about Utica for the defence of the province. At Utica, in particular, the mortality raged to such a degree, that fifteen hundred dead bodies were carried out at one gate in a day. Micipsa had two sons, Adherbal and Hiempsal, whom he educated in his palace, together with his nephew Jugurtha. That young prince was the son of Mastanabal; but his mother having been only a concubine, Masinissa had taken no great notice of him. However, Micipsa considering him as a prince of the blood, took as much care of him as he did of his own children.

Jugurtha possessed several eminent qualities, which gained him universal esteem. He was very handsome, endowed with great strength of body, and adorned with the finest intellectual endowments. He did not devote himself, as young men commonly do, to a life of luxury and pleasure. He used to exercise himself, with persons of his own age, in running, riding, hurling the javelin, and other manly exercises, suited to the martial genius of the Numidians; and although he surpassed all his fellow sportsmen, there was not one of them but loved him. The chase was his only delight; but it was that of lions and other savage beasts. Sallust, to finish the picture of his character, tells us, that he excelled in all things, and spoke very little of himself.

So conspicuous an assemblage of fine talents and perfections at first charmed Micipsa, who thought them an ornament to his kingdom. However, he soon began to reflect that he was considerably advanced in years, and his children in their infancy; that mankind naturally thirsted after power, and that nothing was capable of making men run greater lengths than a vicious and unlimited ambition. These reflections soon excited his jealousy, and determined him to expose Jugurtha to a variety of dangers, some of which, he hoped, might prove fatal to the aspiring youth. With this view he gave Jugurtha the command of a body of forces which he sent to assist the Romans, who were at that time besieging Numantia in Spain. But Jugurtha, by his admirable conduct, not only escaped all those dangers, but likewise won the esteem of the whole army, and the friendship of Scipio, who sent a high character of him to his uncle Micipsa. However, that general gave him some prudent advice in relation to his future conduct; observing in him, no doubt, certain sparks of ambition, which, if lighted into a flame, he apprehended might one day be productive of the most fatal consequences.

Before this last expedition, Micipsa had endeavoured to find out some method of taking him off privately; but the popularity of Jugurtha amongst the Numidians obliged that prince to lay aside all thoughts of this kind. After his return from Spain the whole nation almost adored him. The heroic bravery he had shown there; his undaunted courage, joined to the utmost calmness of mind, which enabled him to preserve a just medium between a timorous foresight and an impetuous rashness, a circumstance rarely to be met with in persons of his age; and, above all, the advantageous testimonials of his conduct given by Scipio, attracted universal esteem. Nay, Micipsa himself, charmed with the high opinion which the Roman general had entertained of his merit, changed his behaviour towards him; resolving, if possible, to win his affection by kindness. He therefore adopted him, and declared him joint heir with his two sons to the crown. Some few years afterwards, finding that his end approached, he sent for all the three to his bed side, where, in the presence of the whole court, he desired Jugurtha to recollect with what extreme tenderness he had treated him, and consequently to consider how well he had deserved at his hands. He then entreated him to protect on all occasions his children, who, being before related to him by the ties of blood, were now by their father's bounty become his brethren. In order to fix him the more firmly in their interest, he likewise complimented him upon his bravery, address, and consummate prudence. He further insinuated, that neither arms nor treasures constitute the strength of a kingdom; but friends, who are neither won by arms nor gold, but by real services and an inviolable fidelity. "Now," continued he, "where can we find better friends than in brothers? And how can that man who becomes an enemy to his relations repose any confidence in or place dependence on strangers?" Then addressing himself to Adherbal and Hiempsal, "And you," said he, "I enjoin to pay always the highest reverence to Jugurtha. Endeavour to imitate, and if possible surpass, his exalted merit, that the world may not hereafter observe Micipsa's adopted son to have reflected greater glory upon his memory than his own children." Soon afterwards, Micipsa, who, according to Diodorus, was a prince of an amiable character, expired. Though Jugurtha did not believe that the king spoke his real sentiments in regard to him, yet he seemed extremely pleased with so gracious a speech, and made him an answer suitable to the occasion. However, that prince at the same time determined within himself to put in execution the scheme he had formed at the siege of Numantia, and which had been suggested to him by some factious and abandoned Roman officers, with whom he there contracted an acquaintance. The purport of this scheme was, that he should extort the crown by force from his two cousins, as soon as their father's eyes were closed; which, they insinuated, might easily be effected by means of his own valour, and the venality of the Romans. Accordingly, a short time after the old king's death, he found means to assassinate Hiempsal in the city of Thirmida, where his treasures were deposited, and to drive Adherbal out of his dominions. That unhappy prince found himself obliged to fly to Rome, where he endeavoured to engage the conscript fathers to espouse his quarrel; but, notwithstanding the evident justice of his cause, they had not virtue enough effectually to support him. Jugurtha's ambassadors, by distributing vast sums of money amongst the senators, brought them so far over that a majority palliated his inhuman proceedings. This encouraged the usurper's ministers to declare that Hiempsal had been killed by the Numidians on account of his excessive cruelty; that Adherbal was the aggressor in the late troubles; and that he was only chagrined because he could not make that havock amongst his countrymen which he would willingly have done. They therefore entreated the senate to form a judgment of Jugurtha's behaviour in Africa from his conduct at Numantia, rather than from the suggestions of his enemies; upon which, by far the greater part of the senate discovered that they were prejudiced in his favour. A few, however, who were not lost to honour nor abandoned to corruption, insisted upon bringing him to condign punishment. But as they could not prevail, Jugurtha had the best part of Numidia allotted him, and Adherbal was forced to rest satisfied with the other.

Jugurtha, finding now by experience that every thing was venal at Rome, as his friends at Numantia had before informed him, thought he might pursue his towering projects without meeting any obstruction from that quarter. He, therefore, immediately after the final division of Micipsa's dominions, threw off the mask, and attacked his cousin by open force. As Adherbal was a prince of a pacific disposition, and almost in all respects the reverse of Jugurtha, he was by no means a match for him. The latter therefore pillaged the territories of the former, stormed several of his fortresses, and overran a good part of his kingdom, without opposition. Adherbal, depending upon the friendship of the Romans, which his father in his last moments had assured him would be a stronger support to him than all the troops and treasures in the universe, despatched deputies to Rome to complain of these hostilities. But whilst he lost valuable time in sending thither fruitless deputations, Jugurtha overthrew him in a pitched battle, and soon afterwards shut him up in Cirta. During the siege of this city, a Roman commission arrived there, in order to persuade both parties to come to an accommodation; but finding Jugurtha untractable, the commissioners returned home without so much as conferring with Adherbal. A second deputation, composed of senators of the highest distinction, with Æmilius Scaurus, president of the senate, at their head, landed some time afterwards at Utica, and summoned Jugurtha to appear before them. That prince at first seemed to be under dreadful apprehensions, especially as Scaurus reproached him with his enormous crimes, and threatened him with the resentment of the Romans if he did not immediately raise the siege of Cirta. However, the Numidian, by his address, and the irresistible power of gold, as was afterwards suspected at Rome, so mollified Scaurus that he left Adherbal at his mercy. In fine, Jugurtha had Cirta at last surrendered to him, upon the condition only that he should spare the life of Adherbal. But the merciless tyrant, in violation of the laws of nature and humanity as well as the capitulation, when he had got possession of the town, ordered him to be put to a most cruel death. The merchants, likewise, and all the Numidians in the place capable of bearing arms, he caused to be put to the sword without distinction.

Every person at Rome inspired with any sentiment of humanity was stricken with horror at the news of this tragical event. However, all the venal senators still concurred with Jugurtha's ministers in palliating his enormous crimes; notwithstanding which, the people, excited thereto by Caius Memmius their tribune, who bitterly inveighed against the venality of the senate, resolved not to let so flagrant an instance of villany go unpunished. This disposition in them induced the conscript fathers likewise to declare their intention to chastise Jugurtha. For this purpose, an army was levied to invade Numidia, and the command of it given to the consul Calpurnius Bestia, a person of good abilities, but rendered unfit for the expedition he was to be employed on by his insatiable avarice. Jugurtha being informed of the great preparations making at Rome to attack his dominions, sent his son thither in hopes of averting the impending storm. The young prince was plentifully supplied with money, which he had orders to distribute liberally amongst the leading men. But Bestia, proposing to himself great advantages from an invasion of Nu-

Numidia. midia, defeated all his intrigues, and got a decree passed, ordering him and his attendants to leave Italy in ten days, unless they were come to deliver up the king himself, and all his territories, to the republic, by way of surrender; which decree being notified to them, they returned without so much as having entered the gates of Rome, and the consul soon afterwards landed with a powerful army in Africa. For some time he carried on the war there very briskly, and having reduced several strongholds, took many Numidians prisoners. But upon the arrival of Scaurus, a peace was granted to Jugurtha upon advantageous terms. That prince having come from Vacca, the place of his residence, to the Roman camp, in order to confer with Bestia and Scaurus, the preliminaries of the treaty were immediately after settled between them in private conferences; and every body at Rome was convinced that the prince of the senate and the consul had sacrificed the republic to their avarice. The indignation of the people, therefore, displayed itself in the strongest manner. Memmius also fired them with his speeches; and it was consequently resolved to despatch the prætor Cassius, a person they could confide in, to Numidia, to prevail upon Jugurtha to come to Rome, that they might learn from the king himself which of their generals and senators had been seduced by the pestilent influence of corruption. Upon his arrival there, Jugurtha found means to bribe one Bæbius Salca, a man of great authority amongst the plebeians, but of insatiable avarice, by whose assistance he escaped with impunity. Nay, by the efficacy of gold, he not only eluded all the endeavours of the people of Rome to bring him to justice, but likewise enabled Bomilcar, one of his attendants, to get Massiva, an illegitimate son of Micipsa, assassinated in the streets of Rome. That young prince was advised by many Romans of probity, wellwishers to the family of Masinissa, to apply for the kingdom of Numidia; which having come to the ears of Jugurtha, he prevented the application by this execrable step. However, he was obliged to leave Italy immediately.

Jugurtha had scarcely set foot in Africa, when he received advice that the senate had annulled the shameful peace concluded with him by Bestia and Scaurus. Soon afterwards, the consul Albinus transported a Roman army into Numidia, flattering himself with the hopes of reducing Jugurtha to reason before the expiration of his consulate. In this, however, he found himself deceived; for that crafty prince, by various artifices, so amused and imposed upon Albinus, that nothing of moment happened in that campaign. This rendered him strongly suspected of having betrayed his country, after the example of his predecessors. His brother Aulus, who succeeded him in the command of the army, was still more unsuccessful; for after raising the siege of Suthul, where the king's treasures were deposited, he marched his forces into a defile, out of which he found it impossible to extricate himself. He was therefore obliged to submit to the ignominious ceremony of passing under the yoke, with all his men, and to quit Numidia entirely in ten days' time, in order to deliver his troops from immediate destruction. The avaricious disposition of the Roman commander had prompted him to besiege Suthul, the possession of which place, he imagined, would make him master of all the wealth of Jugurtha, and consequently paved the way to the scandalous convention just mentioned. However, this was declared void as soon as known at Rome, from being concluded without the authority of the people. The Roman troops retired into Africa Propria, which they had now reduced into the form of a Roman province, and there took up their winter quarters.

In the mean time Caius Mamillius Limetanus, a tribune of the people, excited the plebeians to inquire into the conduct of those persons by whose assistance Jugurtha had found means to elude all the decrees of the senate. This threw the body of the people into a great ferment, and occasioned a prosecution of the guilty senators, which was carried on, for some time, with the utmost heat and violence. Lucius Metellus, the consul, during these transactions, had Numidia assigned him as his province, and consequently was appointed general of the army destined to act against Jugurtha. As he perfectly disregarded wealth, the Numidian found him superior to all his temptations; and to this contempt of money he joined all the other virtues which constitute the great captain, so that Jugurtha found him in all respects inaccessible. That prince, therefore, was now forced to regulate his conduct with the greatest caution, according to the motions of Metellus; and to exert his utmost bravery, in order to compensate for that expedient, hitherto so favourable, which now began to fail him. Marius, Metellus's lieutenant, being likewise a person of uncommon merit, the Romans reduced Vacca, a large and opulent city, and the most celebrated mart in Numidia. They also defeated Jugurtha in a pitched battle; overthrew Bomilcar, one of his generals, upon the banks of the Muthullus; and, in fine, forced the Numidian monarch to take shelter in a place rendered almost inaccessible by the rocks and woods with which it was covered. However, Jugurtha signalized himself in a surprising manner, exhibiting all that could be expected from the courage, abilities, and attention of a consummate general, to whom despair administers fresh strength, and suggests new resources. But his troops could not make head against the Romans, and were again worsted by Marius, though they obliged Metellus to raise the siege of Zama. Jugurtha, therefore, finding his country everywhere ravaged, his most opulent cities plundered, his fortresses reduced, his towns burned, and vast numbers of his subjects put to the sword and taken prisoners, began to think seriously of coming to an accommodation with the Romans. His favourite, Bomilcar, in whom he reposed the highest confidence, but who had been gained over to the enemy by Metellus, observing this disposition, found it no difficult matter to persuade him to deliver up his elephants, money, arms, horses, and deserters, in whom the main strength of his army consisted, into the hands of the Romans. Some of these last, in order to avoid the punishment due to their crime, retired to Bocchus, king of Mauritania, and enlisted into his service. But Metellus, having ordered him to repair to Tisidium, a city of Numidia, there to receive farther directions, Jugurtha refused to comply with that order, and hostilities were renewed with greater fury than ever. Fortune now seemed to declare in favour of Jugurtha, who retook Vacca, and massacred all the Roman garrison, except Turpilius the commandant. However, a Roman legion soon afterwards retook the place, and treated the inhabitants with the utmost severity. About this time, one of Mastanabal's sons, named Gauda, whom Micipsa in his will had appointed to succeed to the crown in case his two legitimate sons and Jugurtha died without issue, wrote to the senate in favour of Marius, who was then endeavouring to supplant Metellus. That prince having his understanding impaired by a declining state of health, fell a more easy prey to the base and infamous adulation of Marius. The Roman, soothing his vanity, assured him, that as he was the next heir to the crown, he might depend upon being fixed upon the Numidian throne as soon as Jugurtha was either killed or taken; and that this must in a short time happen, when once he appeared at the head of the Roman army with an unlimited commission. Soon afterwards, Bomilcar and Nabdalsa formed a design to assassinate Jugurtha, at the instigation of Metellus; but this being detected, Bomilcar and most of his accomplices suffered death. The plot, however, had such an effect upon Jugurtha, that he afterwards enjoyed no tranquillity or repose. He suspected persons of all denominations, Numidians as well as foreigners, of some black designs against him; and perpetual terror sat brooding over his mind, insomuch that he never slept except by stealth, and often changed his bed in a low plebeian manner. Starting from his sleep, he would frequently snatch his sword, and break out into the most doleful cries; so strongly was he haunted by a spirit of fear, jealousy, and distraction.

Jugurtha having destroyed great numbers of his friends on suspicion of their having been concerned in this conspiracy, and many more of them having deserted to the Romans and Bocchus king of Mauritania, he found himself, in a manner, destitute of counsellors, generals, and all persons capable of assisting him in carrying on the war. This threw him into a deep melancholy, which rendered him dissatisfied with every thing, and made him fatigue his troops with a variety of contradictory movements. Sometimes he would advance with great rapidity against the enemy, and at others retreat from them with no small celerity. Then he resumed his former courage, but soon afterwards despaired either of the valour or fidelity of the forces under his command. All his movements, therefore, proved unsuccessful, and at last he was forced by Metellus to accept battle. That part of the Numidian army which Jugurtha commanded behaved with some resolution, but the other fled at the first onset. The Romans, therefore, entirely defeated them, took all their standards, and made some prisoners. But few of them were slain in the action, since, as Sallust observes, the Numidians trusted more to their heels than to their arms for safety in this engagement.

Metellus pursued Jugurtha and his fugitives to Thala. His march to this place being through vast deserts, was extremely tedious and difficult; but being supplied with leathern bottles and wooden vessels of all sizes taken from the huts of the Numidians, which were filled with water brought by the natives who had submitted to him, he advanced towards the city. He had no sooner begun his march, than a most copious shower of rain, a thing very uncommon in these deserts, proved a great and seasonable refreshment to his troops; and this so animated them, that upon their arrival before Thala, they attacked the town with such vigour, that Jugurtha, with his family, and the treasures deposited therein, thought proper to abandon the place. After a brave defence, it was reduced; the garrison, consisting of Roman deserters, setting fire to the king's palace, and consuming themselves, together with every thing valuable to them, in the flames. Jugurtha, being now reduced to great extremities, retired into Gætulia, whence, having formed a considerable corps, he advanced to the confines of Mauritania, and engaged Bocchus, king of that country, who had married his daughter, to enter into an alliance with him; and having reinforced his Gætulian troops with a powerful body of Mauritanians, he turned the tables upon Metellus, and obliged him to keep close within his intrenchments. Sallust informs us, that Jugurtha bribed Bocchus's ministers, in order to influence that prince in his favour; and having obtained an audience, he insinuated that, should Numidia be subdued, Mauritania must be involved in its ruin, especially as the Romans seemed to have vowed the destruction of all the thrones in the universe. In support of what he advanced, he produced several instances very apposite to the point in view. However, the same author seems to intimate, that Bocchus was determined to assist Jugurtha against his enemies by the slight which the Romans had formerly shown him. That prince, at the first breaking out of the war, had sent ambassadors to Rome, to propose an offensive and defensive alliance to the republic, which, though of the utmost consequence at that juncture, a few of the most venal and infamous senators, who were abandoned to corruption, prevented from taking effect. This undoubtedly wrought more powerfully upon Bocchus in favour of Jugurtha than the relation in which he stood to him; for both the Moors and Numidians adapted the number of their wives to their circumstances, so that some of them had ten, twenty, or more. Their kings, therefore, were unlimited in this particular, and of course all degrees of affinity resulting from marriage had but little force. It is observable, that amongst the posterity of those ancient nations the same custom prevails at this day.

Such was the situation of affairs in Numidia, when Metellus received advice of the promotion of Marius to the consulate. But, notwithstanding this injurious treatment, he generously endeavoured to draw off Bocchus from Jugurtha, although this would facilitate the reduction of Numidia for his rival. To this end ambassadors were despatched to the Mauritanian court, who intimated to Bocchus, "that it would be highly imprudent to come to a rupture with the Romans without any cause at all; and that he had now a fine opportunity of concluding a most advantageous treaty with them, which was much preferable to a war." To this they added, "that whatever dependence he might place upon his riches, he ought not to run the hazard of losing his dominions by embroiling himself with other states, when he could easily avoid doing so; that it was much easier to begin a war than to end it, which it was in the power of the victor alone to do; that, in fine, he would by no means consult the interest of his subjects if he followed the desperate fortunes of Jugurtha." To this Bocchus replied, "that for his part there was nothing he wished for more than peace, but that he could not help pitying the deplorable condition of Jugurtha; that if the Romans, therefore, would grant to that unfortunate prince the same terms which they had offered him, he would bring about an accommodation." Metellus let the Mauritanian monarch know, that it was not in his power to comply with what he desired; but he nevertheless took care to keep up a private negotiation with him till the arrival of the new consul Marius. By this conduct he gained two important objects. First, he prevented Bocchus from coming to a general action with his troops; which was the very thing Jugurtha desired, hoping that this, whatever the event might be, would render a reconciliation between him and the Romans impracticable. Secondly, this inaction enabled him to discover something of the genius and disposition of the Moors, a nation of whom the Romans, till then, had scarcely formed any idea; and this, he imagined, might be of no small service, either to himself or his successors, in the future prosecution of the war.

Jugurtha, being informed that Marius, with a numerous army, had landed at Utica, advised Bocchus to retire, with part of the troops, to some place of difficult access, whilst he himself took post upon another inaccessible spot with the remaining corps. By this measure, he hoped the Romans would be obliged to divide their forces, and consequently be more exposed to his efforts and attacks. He likewise imagined, that seeing no formidable body appear, they would believe that the enemy were not in a condition to make head against them; which might occasion a relaxation of discipline, the usual attendant of too great security, and consequently produce some good effect. However, he was disappointed in both these views. For Marius, so far from suffering a relaxation of discipline to take place, trained up his troops, which consisted chiefly of new levies, in so perfect a manner, that they were soon equal in efficiency to any consular army that ever appeared in the field. He also cut off great numbers of the Gætulian marauders, defeated many of Jugurtha's parties, and had well nigh captured that prince himself near the city of Cirta. These advantages, though not of any great importance, intimidated Bocchus, who now made overtures for an accom-

Numidia. modation; but the Romans, not being sufficiently satisfied of his sincerity, paid no great attention to them. In the mean time Marius pushed on his conquests, and having reduced several places of less note, at last resolved to besiege Capsa. That this enterprise might be conducted with the greater secrecy, he suffered not the least hint of his design to transpire, even amongst any of his officers. On the contrary, in order to blind them, he detached A. Manlius, one of his lieutenants, with some light-armed cohorts, to the city of Lares, where he had fixed his principal magazine, and deposited the military chest. Before Manlius left the camp, that he might the more effectually amuse him, he intimated, that he himself with the army would take the same route in a few days; but instead of that, he bent his march towards the Tanais, and in six days' time arrived upon the banks of that river. Here he pitched his tents for a short time, in order to refresh his troops; after which he advanced to Capsa, and made himself master of the place. As the situation of this city rendered it extremely commodious to Jugurtha, whose plan of operations, ever since the commencement of the war, it had exceedingly favoured, Marius levelled it with the ground after it had been delivered up to the soldiers to be plundered. The citizens, likewise, being more strongly attached to that prince than any of the other Numidians, on account of the extraordinary privileges he indulged them with, and of course bearing a more implacable hatred to the Romans, he put to the sword or sold for slaves. The true motive of the consul's conduct on this occasion seems to have been that assigned; though we are told by Sallust, in conformity to the Roman genius, that neither avarice nor resentment prompted him to so barbarous an action, but only a desire to strike terror into the Numidians.

The Numidians, ever after this exploit, dreaded the very name of Marius; who now, in his own opinion, had eclipsed the glory of all the great achievements of his predecessor, particularly the reduction of Thala, a city in strength and situation nearly resembling Capsa. Following up this blow, he gradually presented himself before most of the places of strength in the enemy's country, many of which either opened their gates or were abandoned at his approach, being terrified at what had happened to the unfortunate citizens of Capsa. Others taken by force he laid in ashes, and, in short, filled the greatest part of Numidia with blood, horror, and confusion. Then, after an obstinate defence, he reduced a castle which seemed impregnable, being situated not far from Mulucha, where Jugurtha kept part of his treasures. In the mean time, Jugurtha not being able to prevail upon Bocchus, by his repeated solicitations, to advance into Numidia, where he found himself greatly pressed, was obliged to have recourse to his usual method of bribing the Mauritanian ministers, in order to put that prince in motion. He also promised him a third part of his kingdom, provided they could either drive the Romans out of Africa, or get all the Numidian dominions confirmed to him by treaty.

So considerable a cession could scarcely fail to engage Bocchus to support Jugurtha with his whole power. The two African monarchs, therefore, having joined their forces, surprised Marius near Cirta as he was going into winter quarters. The Roman general was so hard pushed on this occasion, that the barbarians thought themselves certain of victory, and doubted not but they should be able to extinguish the Roman name in Numidia. But their want of caution, and too great security, enabled Marius to inflict on them a total defeat; which was followed four days afterwards by so complete an overthrow, that their numerous army, consisting of ninety thousand men, by the accession of a powerful corps of Moors, commanded by Bocchus's son Volux, was entirely ruined. Sylla, the lieutenant of Marius, most eminently distinguished himself in the last action, which laid the foundation of his future greatness. Bocchus, now looking upon Jugurtha's condition as desperate, and not being willing to run the risk of losing his dominions, showed a disposition to conclude a peace with Rome. However, the republic gave him to understand, that he must not expect to be ranked amongst its friends, until he had delivered up into the consul's hands Jugurtha, the inveterate enemy of the Roman name. The Mauritanian monarch, having entertained a high idea of an alliance with that state, resolved to satisfy it in this particular; and was confirmed in his resolution by one Dabar, a Numidian prince, the son of Massugrada, and descended by his mother's side from Masinissa. Being closely attached to the Romans, and extremely agreeable to Bocchus on account of his noble disposition, he defeated all the intrigues of Aspar, the minister of Jugurtha. Upon Sylla's arrival at the Mauritanian court, the affair there seemed to be entirely settled. However, Bocchus, who was continually projecting new designs, and, like the rest of his countrymen, in the highest degree perfidious, debated within himself whether he should sacrifice Sylla or Jugurtha, who were then both in his power. He was a long time fluctuating in uncertainty, and distracted by a contrariety of sentiments. The sudden changes which displayed themselves in his countenance, his air, and his whole person, evidently showed how strongly his mind was agitated. But at last he returned to his first design, to which the bias of his mind seemed naturally to lead him. He therefore delivered up Jugurtha into the hands of Sylla, to be conducted to Marius, who, by that important event, happily terminated this dangerous war. The kingdom of Numidia was now reduced to a new form. Bocchus, for his important services, had the country of the Massæsyli, contiguous to Mauritania, assigned him, and which, from this time, took the name of New Mauritania. Numidia Propria, or the country of the Massyli, was divided into three parts; one of which was given to Hiempsal, and another to Mandrestal, both descendants of Masinissa; and the third part the Romans annexed to Africa Propria, or the Roman province adjacent to it.

Jugurtha's two sons survived him, but spent their lives in captivity at Venusia. One of them, however, named Oxyntas, was, for a short time, released from his confinement by Aponius, who besieged Acerræ, in the war between the Romans and the Italian allies. That general brought this prince to his army, where he treated him as king, in order to draw off the Numidian forces from the Roman service. Accordingly, those Numidians no sooner heard that the son of their old king was fighting for the allies, than they began to desert by companies; a circumstance which obliged Julius Cæsar the consul to part with all his Numidian cavalry, and send them back into Africa. Some few years after this event, Pompey defeated Cneius Domitius Ahenobarbus, and Hiarbas one of the kings of Numidia, killing seventeen thousand of their men upon the field of battle; and, not satisfied with this victory, that general pursued the fugitives to their camp, which he soon forced, and, having put Domitius to the sword, took Hiarbas prisoner. He then reduced that part of Numidia which belonged to Hiarbas, who seems to have succeeded Mandrestal above mentioned, and gave it to Hiempsal, a neighbouring Numidian prince, descended from Masinissa, who had always opposed the Marian faction.

Suetonius informs us, that a dispute happened between Hiempsal and one Masintha, a noble Numidian, whom, it is probable, he had in some respect injured, at the time when Julius Cæsar first began to make a figure in the world. The same author adds, that Cæsar warmly espoused the cause of Masintha, and even grossly insulted Juba, Hiempsal's son, when he attempted to vindicate his father's conduct on this occasion. He pulled him by the beard, than which a more unpardonable affront could not be offered to an African. In short, he screened Masintha from the insults and violence of his enemies; and from this cause a reason may be assigned for Juba's adhering so closely afterwards to the Pompeian faction.

In consequence of the indignity Cæsar had offered Juba, and the disposition it had occasioned, that prince did Cæsar great damage in the civil wars between him and Pompey. By a stratagem he drew Curio, one of his lieutenants, into a general action, which it was his interest at that time to have avoided. He caused it to be given out over all Africa Propria and Numidia, that he had retired into some remote country at a great distance from the Roman territories. This coming to Curio's ears, who was then besieging Utica, hindered him from taking the necessary precautions against a surprise. Soon afterwards, the Roman general receiving intelligence that a small body of Numidians was approaching his camp, put himself at the head of his forces in order to attack them, and, for fear they should escape, began his march in the night, looking upon himself as certain of victory. Some of their advanced posts he surprised asleep, and cut them to pieces, which still farther animated him. In short, about daybreak he came up with the Numidians, whom he attacked with great bravery, though his men were then fasting, and greatly fatigued by their forced and precipitate march. In the mean time, Juba, who immediately after the propagation of the rumour above mentioned had taken care to march privately, with the main body of the Numidian army, to support the detachment sent before to decoy Curio, advanced to the relief of his men. The Romans had met with a vigorous resistance before he appeared, so that he easily broke them; killed Curio, with a great part of his troops, upon the spot; pursued the rest to their camp, which he plundered; and took many of them prisoners. Most of the fugitives, who endeavoured to make their escape on board the ships in the port of Utica, were either slain by the pursuers, or drowned in the attempt. The remainder fell into the hands of Varus, who would have saved them; but Juba, who arrogated to himself the honour of this victory, ordered most of them to be put to the sword.

This victory infused new life and vigour into the Pompeian faction, who thereupon conferred great honours upon Juba, and gave him the title of king of all Numidia. But Cæsar and his adherents declared him an enemy to the state of Rome, adjudging to Bocchus and Bogud, two African princes entirely in their interest, the sovereignty of his dominions. Juba afterwards, uniting his forces with those of Scipio, reduced Cæsar to great extremities, and would, in all probability, have totally ruined him, had he not been relieved by Publius Sittius. That general, having formed a considerable corps, consisting of Roman exiles, and Mauritanian troops sent him by Bocchus, according to Dio, or, as Cæsar will have it, Bogud, made an irruption into Gætulia and Numidia, whilst Juba was employed in Africa Propria. As he ravaged these countries in a dreadful manner, Juba immediately returned with the best part of his army, in order to preserve them from utter destruction. However, Cæsar knowing that his horse were afraid of the enemy's elephants, did not think proper to attack Scipio in the absence of the Numidian, till his own elephants, and a fresh reinforcement of troops, hourly expected, arrived from Italy. With this accession of strength, he imagined himself able to give a good account, both of the Roman forces with which he was to cope, and of the barbarians. In the mean time Scipio despatched reiterated expresses to Juba to hasten to his assistance, but could not prevail upon him to move out of Numidia, till he had promised him the possession of all the Roman dominions in Africa if they could expel Cæsar from thence. This immediately put him in motion; so that, having sent a large detachment to make head against Sittius, he marched with the rest of his troops to assist Scipio. However, Cæsar at last overthrew Scipio, Juba, and Labienus, near the town of Thapsus, and forced all their camps. As Scipio was the first surprised and defeated, Juba fled into Numidia without waiting for Cæsar's approach; but the body of the Numidians detached against Sittius having been broken and dispersed by that general, none of his subjects there would receive him. Abandoned to despair, he sought death in a single combat with Petreius, and having killed him, caused himself to be despatched by one of his slaves.

After this decisive action, and the reduction of all Africa Propria, Cæsar made himself master of Numidia, which he reduced to a Roman province, appointing Crispus Sallustius to govern it in quality of proconsul, with private instructions to pillage and plunder the inhabitants, and by these means put it out of their power ever to shake off the Roman yoke. However, Bocchus and Bogud still preserved a sort of sovereignty in the country of the Massæsyli and Mauritania; since the former of these princes, having deserted Cæsar, sent an army into Spain to assist the Pompeians; and the latter, with his forces, determined victory in favour of Cæsar at the memorable battle of Munda. Bogud, afterwards siding with Antony against Octavius, sent a body of forces to assist him in Spain; but at this time the Tingitanians having revolted from him, Bocchus, with an army composed of Romans in the interest of Octavius, who passed over from Spain into Africa, and his own subjects, possessed himself of Mauritania Tingitana. Bogud fled to Antony; and Octavius, after the conclusion of the war, honoured the inhabitants of Tingi with all the privileges of Roman citizens. He likewise confirmed Bocchus king of Mauritania Cæsariensis, or the country of the Massæsyli, in the possession of Tingitana, which he had conquered, as a reward for his important services. In this he imitated the example of his great predecessor Julius Cæsar, who divided some of the fruitful plains of Numidia amongst the soldiers of Sittius, who had conquered the greater part of that country, and appointed Sittius himself sovereign of that district. Sittius, as has been intimated above, having taken Cirta, killed Sabura, Juba's general, entirely dispersed his forces, and either cut off or taken prisoners most of the Pompeian fugitives who escaped from the battle of Thapsus, highly deserved to be distinguished in so eminent a manner. After the death of Bocchus, Mauritania and the Massæsylian Numidia were in all respects considered as Roman provinces.

NUMISMATOGRAPHIA, a term applied to the description and knowledge of ancient coins and medals, whether of gold, silver, or brass.

NUN, the son of Elishamah, and father of Joshua, of the tribe of Ephraim. The Greeks gave him the name of *Nane* instead of Nun. This person is only known in sacred history by having been the father of Joshua.

NUN, a woman, in several Christian countries, who devotes herself, in a cloister or nunnery, to a religious life. There were women, in the ancient Christian church, who made public profession of virginity, before the monastic life was known in the world, as appears from the writings of Cyprian and Tertullian. These, for distinction's sake, are sometimes called "ecclesiastical virgins," and were commonly enrolled in the canon or matricula of the church. They differed from the monastic virgins chiefly in this, that they lived privately in their fathers' houses, whereas the others lived in communities; but their profession of virginity was not so strict as to make it criminal for them afterwards to marry, if they thought fit. As to the consecration of virgins, it had some things peculiar in it, and was usually performed publicly in the church by the bishop. The virgin made a public profession of her resolution, and then the bishop put upon her the accustomed habit of sacred virgins. One part of this habit was a veil called the *sacrum velamen*; and another was a kind of mitre or coronet worn upon the head. At present, when a woman is to be made a nun, the habit, veil, and ring of the candidate are carried to the altar; and she herself, accompanied by her nearest relations, is conducted to the bishop, who, after mass and an anthem, pronounces the benediction; upon which she rises up, and the bishop consecrates the new habit, sprinkling it with holy water. When the candidate has put on her religious habit, she presents herself before the bishop, and sings, on her knees, *Ancilla Christi sum;* then she receives the veil, and afterwards the ring, by which she is married to Christ; and, lastly, the crown of virginity. When she is crowned, an anathema is denounced against all who shall attempt to induce her to break her vows.

NUNCIO, or NUNTIO, an ambassador from the pope to some Catholic prince or state, or a person who attends on behalf of the pope at a congress, or an assembly of several ambassadors.

NUNCUPATIVE, in the schools, means something that is only nominal, or has no existence but in name.

NUNCUPATIVE Will or *Testament*, a will made verbally, and not put in writing.

NUNDABAR, a town of Hindustan, in the province of Khandesh, belonging to the Mahrattas, seventy-six miles east from Surat. Long. 74. 15. E. Lat. 21. 17. N.

NUNDAPORAM, a town of Hindustan, in the Northern Circars, and district of Cicacole, eighty-two miles west from Cicacole. Long. 82. 40. E. Lat. 18. 23. N.

NUNDINA, a goddess amongst the ancient heathens, supposed to have had the care of the purification of infants. Because male infants were purified nine days after their birth, her name is derived from *nonus*, or the ninth; although female infants were also purified on the eighth day, which purification was by the Romans called *lustration.*

NUNDINAL, *Nundinalis*, a name which the Romans gave to the first eight letters of the alphabet, which were used in their calendar. This series of letters, A, B, C, D, E, F, G, H, is placed and repeated successively from the first to the last day of the year; and one of these always expressed the market-days or the assemblies called *nundinæ* (quasi novendinæ), because they returned every nine days. The country people, after working eight days successively, repaired to town on the ninth to sell their several commodities, and to inform themselves of all that related to religion and government. Thus the nundinal day being under A on the first, ninth, seventeenth, and twenty-fifth days of January, &c. the letter D will be the nundinal letter of the year following. These nundinals bear a very great resemblance to the dominical letters, which return every eight days, as the nundinals did every nine.

NUNDYDROOG, a celebrated and strong hill fortress of Hindustan, in the province of Mysore. The mountain on which it is built is 1700 feet high, and it is inaccessible on three sides. This fortress, always considered as impregnable, was stormed by the British in 1791, after a siege of three weeks. The neighbouring country is fertile, being studded with hills, in which there is much fertile land. It was long ruled by one of those independent chiefs called poligars in Southern India. He was compelled to pay tribute to Hyder Aly, who ravaged his territories and laid waste the country. Long. 77. 53. E. Lat. 13. 22. N.

NUNEATON, a town of the county of Warwick, in the hundred of Hemlingford, ninety-nine miles from London, and eight from Coventry. It stands on the river Anker, and had formerly a nunnery, to which it owes its name. It partakes of the trade of Coventry, like that place making many ribbons, and, besides, some woollen goods. There is a market on Saturday. The population amounted in 1801 to 4796, in 1811 to 4947, in 1821 to 6610, and in 1831 to 7799.

NUNIA, a village of Irak Arabi, about three quarters of a mile from the Tigris, opposite to Mosul. It is supposed to be the site of the ancient Nineveh. The history of this metropolis is lost in succeeding ages, and it appears to have fallen into decay after the building of Babylon; indeed in the reign of Hadrian it was so completely destroyed, that even the place where it stood was unknown. A city erected afterwards near the spot was called Ninus; and Mr Kinneir is of opinion that it is the ruins of the latter, and not those of old Nineveh, that are still visible. He mentions that he examined these remains in 1810, and that they consisted of a rampart and fosse, forming an oblong square four miles in compass. The wall is on an average twenty feet in height, and is covered with grass, like the Roman intrenchments in England.

NUPTIAL RITES, the ceremonies attending the solemnization of marriage, which are different in different ages and countries. We cannot omit here a custom which was practised by the Romans on these occasions. Immediately after the principal ceremonies were ended, the new married man threw nuts about the room for the boys to scramble for. Various reasons have been assigned for this; but that which most generally prevails, and seems to be the most probable, is, that by this act the bridegroom signified his resolution to abandon trifles, and commence a serious course of life. Hence *nucibus relictis* became in this sense a proverb. The nuts might also be an emblem of fertility. The ancient Greeks had a person to conduct the bride from her own to the bridegroom's house, and hence he was called by the Greeks *Nymphagogus*, which term was afterwards used both by the Romans and the Jews.

NUREMBURG, or NURNBERG, a city of Bavaria, in the circle of the Rezat, and the bailiwick of the same name, of which it is the capital. It is situated on the river Pegnitz, which divides it into two parts. The walls are now kept in a state which renders them indefensible. It is an extensive but thinly peopled city, having much declined from the prosperity it enjoyed in the middle ages, when it was a free imperial city, and the place where the emperors occasionally resided. The city now contains 4500 houses, and 28,200 inhabitants, with eight Lutheran churches, one for the Catholics, and a chapel for the Calvinists. It has also many Jews. It is still a place of considerable manufactures, but they are chiefly on a small scale, furnishing the turnery wares called by its name, cutlery, braziery, looking-glasses, spectacles, needles, mathematical, musical, and surgical instruments, watches, leaf gold and silver, paper, maps, and other articles. It is celebrated as the birthplace of Albert Durer the painter, and the residence of Rudolph the inventor of wire, of Peter Hele the inventor of watches, of Denner the inventor of the clarionet, of Ebner the first cutler, and of Behairn, who first constructed globes. Long. 11. 1. 4. E. Lat. 49. 27. 8. N.

NURPOOR, a town of Hindustan, in the province of Lahore, and capital of a district of the same name. It is situated on the top of a hill, which is ascended by stone steps, and has all the appearance of opulence and industry. It is the residence of a Sikh chief, whose revenue amounts to L.50,000 a year. The district is situated between the thirty-second and thirty-third degrees of north latitude. It belongs to the Sikhs. The city is seventy-five miles east-north-east from the city of Lahore.

NURRAH, a town of Hindustan, in the province of Gundwana, tributary to the Nagpoor rajah, and possessed by native Goand chiefs. It is seventy-eight miles south by east from Ruttunpoor. Long. 82. 45. E. Lat. 21. 2. N.

NURSERY, in *Gardening*, is a piece of land set apart for raising and propagating all sorts of trees and plants to supply the garden and other plantations.

NURSING OF CHILDREN. The following observations and directions were published in the Annual Register (vol. vi. p. 130), as the results of long experience. The child should be laid, the first month, upon a thin mattress, rather longer than itself, which the nurse should keep upon her lap, that the child may always lie straight, and only sit up as the nurse slants the mattress. To set a child quite upright before the end of the first month, would hurt the eyes, by making the white part of the eye appear below the upper eyelid. Afterwards the nurse will begin to set it up and dance it by degrees. The child must be kept as dry as possible.

The clothing should be very light, and not much longer than the child, that the legs may be got at with ease, in order to have them often rubbed in the day with a warm hand or flannel, and in particular the inside of them.

Rubbing a child all over takes off scurf, and causes the blood to circulate. The one breast should be rubbed with the hands one way, and the other the other way, night and morning at least.

The ankle bones and the inside of the knees should be rubbed twice a day; this will strengthen those parts, and make the child stretch its knees and keep them flat, which is the foundation of an erect and graceful person.

A nurse ought to keep a child as little in her arms as possible, lest the legs should be cramped, and the toes turned inwards. Further, she should always keep the child's legs loose. The oftener the posture is changed the better. Tossing a child about, and exercising it in the open air in fine weather, is of the greatest service. In cities, children are not to be kept in hot rooms, but to have as much air as possible. Want of exercise is the cause of large heads, weak and knotted joints, a contracted breast, which occasions coughs and stuffed lungs, an ill-shaped person, and waddling gait, besides a numerous train of other ills.

The child's flesh is to be kept perfectly clean, by constantly washing its limbs, and likewise its neck and ears, beginning with warm water, till by degrees it will not only bear, but like to be washed with cold water.

Rising early in the morning is good for all children, provided they awake of themselves, which they generally do; but they are never to be waked out of their sleep, and as soon as possible to be brought to regular sleeps in the day. When laid in bed or in cradle, their legs are always to be laid straight.

Children, till they are two or three years old, must never be suffered to walk long enough at a time to be weary.

Girls might easily be trained to the proper management of children, if a premium were given in free schools, workhouses, and other places, to those that brought up the finest child to one year old.

If the mother cannot suckle the child, get a wholesome cheerful woman with young milk, who has been used to attend young children. After the first six months, small broths, and innocent foods of any kind, may do as well as living wholly upon milk. A principal thing to be always attended to is, to give young children constant exercise, and to keep them in a proper posture.

With regard to the child's dress in the day, let it be a shirt, a petticoat of fine flannel two or three inches longer than the child's feet, with a dimity top, commonly called a boddice coat, to tie behind; and over that a surcingle made of fine buckram, two inches broad, covered over with satin or fine ticken, with a ribbon fastened to it to tie it on, which answers every purpose of stays, and has none of their inconveniences. Over this put a robe, or a slip and frock, or whatever you like best, provided it is fastened behind, and not much longer than the child's feet, that their motions may be strictly observed. Two caps are to be put on the head, till the child has got most of its teeth. The child's dress for the night may be a shirt, a blanket to tie on, and a thin gown to tie over the blanket.

NUSANCE, or Nuisance, in *Law*, a thing done to the annoyance of another. Nuisances are either public or private. A public nuisance is an offence against the public in general, either by doing what tends to the annoyance of all the king's subjects, or by neglecting to do what the common good requires; in which case, all annoyances and injuries to streets, highways, bridges, and large rivers, as also disorderly ale-houses, gaming-houses, and the like, are held to be common nuisances. A private nuisance is, when only one person or family is annoyed by the doing of any thing; as where a person stops up the light of another's house, or builds in such a manner that the rain falls from his house upon his neighbour's.

NUSSERABAD, a town of Hindustan, in the Mahratta dominions, and province of Berar, forty-two miles south-west from Burhampoor. Long. 75. 51. E. Lat. 20. 56. N.

NUSSERITABAD, or Sackur, a town of Hindustan, in the province of Bejapore, belonging to the nizam.

NUSSERPOOR, a town of Hindustan, in the province of Sinde, and the capital of a district of the same name, situated near the banks of the Indus. Long. 69. 10. E. Lat. 25. 28. N. The district is situated principally between the twenty-sixth and twenty-seventh degrees of north latitude, and is intersected by the river Indus.

NUT, among botanists, denotes a *pericarpium* of an extraordinary hardness, enclosing a kernel or seed.

NUTATION, in *Astronomy*, a kind of tremulous motion of the axis of the earth, by which, in each annual revolution, it is twice inclined to the ecliptic, and as often returns to its former position.

NUTHUIRS, a village of Persia, in the province of Irak, situated on a small plain surrounded with mountains, on the road from Ispahan to Sultania, and sixty-three miles north from Ispahan.

NUTMEG, the fruit of a tree, and a well-known spice. See Myristica.

NUTRITION, in the animal economy, is the repairing the continual loss which the different parts of the body undergo. The motion of the parts of the body, the friction of these parts against each other, and especially the action of the air, would destroy the body entirely, if the loss was not repaired by a proper diet containing nutritive juices, which being digested in the stomach, and afterwards converted into chyle, mix with the blood, and are distributed throughout the whole body for its nutrition.

Buffon, in order to account for nutrition, supposes the body of an animal or vegetable to be a kind of mould, in which the matter necessary to its nutrition is modelled and assimilated to the whole. But of what nature is this matter which an animal or a vegetable assimilates to its own substance? What power is it that communicates to this matter the activity and motion necessary to penetrate this mould? and, if such a force exist, would it not be by a similar force that the internal mould itself might be reproduced?

As to the first question, he supposes that there exists in nature an infinite number of living organical parts, and that all organized bodies consist of such organical parts; that their production costs nature nothing, since their existence is constant and invariable; so that the matter which the animal or vegetable assimilates to its substance is an organical matter of the same nature with that of the animal or vegetable, which consequently may augment its volume without changing its form or altering the quality of the substance in the mould.

As to the second, there exist in nature certain powers, as that of gravity, which have no affinity with the external qualities of the body, but act upon the most intimate parts, and penetrate them throughout, and which can never fall under the observation of our senses.

And as to the third, he conceives that the internal mould itself is reproduced, not only by a similar power, but by the very same power which causes the unfolding and reproduction thereof. For it is sufficient, he thinks, that, in an organized body which unfolds itself, there should be some part similar to the whole, in order that this part may one day become itself an organized body, altogether like that of which it is actually a part.

NUX VOMICA, a flat, compressed, round fruit, about the breadth of a shilling, brought from the East Indies. It is found to be a certain poison for dogs, cats, and other animals, and it is not to be doubted that it would also prove fatal to man. Its surface is not much corrugated, and its texture is firm like horn, and of a pale grayish-brown colour. It is said to be used as a specific against the bite of a species of water-snake. It is considerably bitter and deleterious; but has been used in doses of from five to ten grains twice a day or so, in intermittents, particularly obstinate quartans, and in contagious dysentery. The *strychnus Ignatii* is a tree of the same kind producing gourd-like fruit, the seeds of which are improperly called St Ignatius's beans. These, as also the woods or roots of some such trees, called *lignum colubrinum*, or snakewood, are very narcotic bitters, like the *nux vomica.*

NUYTS, PETER, a native of Holland, and a leading character in that extraordinary transaction which happened between the Japanese and the Dutch about the year 1628. In 1627 Nuyts arrived in Batavia from Holland, and was in the same year appointed ambassador to the emperor of Japan, by the governor and council of Batavia. He repaired to that empire in 1628; and being a man of a haughty disposition, and extremely vain, he believed it practicable to pass upon the natives for an ambassador from the king of Holland. Upon his assuming this title and rank, he was much more honourably received, caressed, and respected than former ministers had been. But he was soon detected, reprimanded, and reproached in the severest manner, sent back to the port, and ordered to return to Batavia with all the circumstances of disgrace imaginable; notwithstanding which, his interest was so great, that, instead of being punished as he deserved, he was immediately afterwards promoted to the government of the island of Formosa, of which he took possession in the following year. He entered upon the administration of affairs in that island with the same disposition that he had shown whilst ambassador, and with the most implacable resentment against the Japanese; neither was it long before an opportunity offered, as he thought, of revenging himself on them to the full. Two large Japanese ships, with upwards of five hundred men on board, came into the port, upon which he took it into his head to disarm and unrig them, in the same manner as the Dutch vessels are treated at Japan. The Japanese did all they could to defend themselves from this ill usage; but at last, for want of water, they were forced to submit. Governor Nuyts went still farther. When they had finished their affairs at Formosa, and were desirous of proceeding, according to their instructions, to China, he put them off with fair words and fine promises, till the monsoon was over. They then began to be very impatient, and desired to have their cannon and sails restored, that they might return home; but the governor had recourse to new artifices, and, by a series of false promises, endeavoured to prevent them from making use of the season most proper for that voyage. The Japanese, however, soon perceived his design, and at length, by a bold attempt, accomplished what, by fair means and humble entreaty, they could not obtain; for, by a daring and well concerted effort, they took him prisoner, and compelled him and one of the council to sign a treaty for securing their liberty, free departure, and indemnity, which was afterwards ratified by the whole council. Nuyts was first confined in Batavia, and afterwards delivered up to the Japanese, notwithstanding the most earnest entreaties on his part to be tried, and even to suffer any kind of death, where he was, rather than to be sent to Japan. Thither, however, he was sent in 1634, when he was submitted to the mercy or discretion of the emperor; and the consequence was, that, though imprisoned, he was well used, and could go anywhere, provided his guards were with him, which was more than he could possibly have expected. He now looked for nothing but the continuance of his confinement for life. On a particular occasion, however, namely, the funeral of the emperor's father, he was, at the request of the Dutch, set free, and returned again to Batavia, to the surprise of the people of that settlement, who adopted ever afterwards a very different conduct with respect to the Japanese.

NUYTS' REEFS, several large reefs of rocks which lie off the south coast of New Holland, at Cape Nuyts. These reefs are about eight miles distant from the coast, and are eight miles in length. In some places the rocks rise above the water, and in others they are wholly concealed. Long. of Cape Nuyts, 132. 18. E. Lat. 32. 2. S.

NUZZER, or MUZZERANAH, a present or offering from an inferior to a superior. In Hindustan no man ever approaches his superior for the first time on business without an offering of at least a gold or silver rupee in his right hand; and if this be not taken, it is a mark of disfavour. Nuzzeranah is also used to signify the sum paid to the government as an acknowledgment for a grant of lands or any public office.

NYCHTHEMERON, amongst the ancients, signified the whole natural day, or day and night, consisting of twenty-four hours, or twenty-four equal parts. This way of considering the day was particularly adopted by the Jews, and seems to have owed its origin to the expression of Moses in the first chapter of Genesis, "The evening and the morning were the first day." Before the Jews had introduced the Greek language into their discourse, they were accustomed to indicate this space of time by the simple expression of a night and a day.

It is proper here to observe, that in all the eastern countries any part of a day of twenty-four hours was reckoned for a whole day; and that a thing which was done on the third or seventh day from that last mentioned, was said to be done after three or seven days. The Hebrews, having no word which exactly answered to the Greek Νυχθημερον, signifying a natural day of twenty-four hours, used *night and day*, or *day and night*, instead of it; so that to say a thing happened after three days and three nights, was, with them, the same as to say that it happened after three days, or on the third day. This being remembered, will explain what is meant by "the Son of Man's being three days and three nights in the heart of the earth."

NYCTASTRATEGI, amongst the ancients, were officers appointed to prevent fires in the night, or to give alarm and call assistance when a fire broke out. At Rome they had the command of the watch, and were called *nocturni triumviri*, from their office and number.

NYIREGYHAZA, a town of the circle of Szaboles, in the province of Farther Theiss, in Hungary. It contains a Catholic, a Lutheran, a Calvinist, and an Unitarian church, a public grammar-school, 1100 houses, and 8066 inhabitants, who are employed in cultivating the vine, and in several trades. Long. 22. 38. 10. E. Lat. 47. 56. 45. N.

NYKOPING, a province of the west of Sweden, which extends in north latitude from 58. 36. to 59. 30., and in east longitude from 15. 28. to 17. 33., and contains 2977 square miles. It comprises seven cities or towns, and 3327 detached settlements, with 98,500 inhabitants. It is a district of mountains and lakes, intermingled with extensive woods, but barely produces corn sufficient for its scanty population. The chief occupation consists in copper and iron mines, and in the fishery. The capital is a city of the same name, situated on a bay in the Baltic Sea.

It is a well-built town, and has a market-place, surrounded with houses of stone, but most of the others are of wood. It contains two churches, and 520 dwellings, with 2490 inhabitants, who make cutlery and bar iron, and export large quantities of deals and other wood. Long. 16. 57. 10. E. Lat. 58. 45. 30. N.

NYLACKY, one of the Banda Islands, in the Eastern Seas. Long. 130. 33. E. Lat. 4. 11. S.

NYMPH, in *Mythology*, an appellation given to certain inferior goddesses, inhabiting the mountains, woods, and waters, and said to have been the daughters of Oceanus and Tethys. All the universe was represented as full of these nymphs, who were distinguished into several ranks or classes. The general division of them was into celestial and terrestrial. The former were called *Uraniæ*, and were supposed to be intelligences which governed the heavenly bodies or spheres. The terrestrial nymphs, called *Epigeiæ*, were believed to preside over the several parts of the inferior world, and were divided into those of the water and those of the earth. The nymphs of the water were the *Oceanitides*, or nymphs of the ocean; the *Nereids*, or the nymphs of the sea; the *Naiads* and *Ephydriades*, or the nymphs of the fountains; and the *Limniades*, or the nymphs of the lakes. The nymphs of the earth were the *Oreades*, or nymphs of the mountains; the *Napææ*, or nymphs of the meadows; and the *Dryads* and *Hamadryads*, who were nymphs of the forests and groves. Besides these, we meet with nymphs who took their names from particular countries, rivers, and places.

"The nymphs," says Dr Chandler, "were supposed to enjoy longevity, but not to be immortal. They were believed to delight in springs and fountains. They are described as sleepless, and as dreaded by the country people. They were susceptible of passion. The Argonauts, it is related, landing on the shore of the Propontis to dine, in their way to Colchis, sent Hylas, a boy, for water, who discovered a lonely fountain, in which the nymphs Eunica, Malis, and Nycheia, were preparing to dance; and these seeing him were enamoured, and, seizing him by the hand as he was filling his vase, pulled him in. The deities, their copartners in the cave, are such as presided with them over rural and pastoral affairs.

"The old Athenians were ever ready to cry out, a gód, or a goddess. The tyrant Pisistratus entered the city in a chariot with a tall woman dressed in armour to resemble Minerva, and regained the Acropolis, which he had been forced to abandon, by this stratagem; the people worshipping, and believing her to be the deity whom she represented. The nymphs, it was the popular persuasion, occasionally appeared; and nympholepsy is characterised as a frenzy which arose from having beheld them. Superstition disposed the mind to adopt delusion for reality, and gave to a fancied vision the efficacy of full conviction. The foundation was perhaps no more than an indirect, partial, or obscure view of some harmless girl, who had approached the fountain on a like errand with Hylas, or was retiring after she had filled her earthen pitcher.

"Amongst the sacred caves on record, one on Mount Ida in Crete was the property of Jupiter, and one by Lebadea in Bœotia, of Trophonius. Both these were oracular, and the latter bore some resemblance to that which we have described. It was formed by art, and the mouth surrounded with a wall. The descent to the landing place was by a light and narrow ladder, occasionally applied and removed. It was situated on a mountain above a grove; and the story goes, that a swarm of bees conducted the person by whom it was first discovered. But the common owners of caves were the nymphs, and these were sometimes local. On Cithæron, in Bœotia, many of the inhabitants were possessed by nymphs called *Sphragitides*, whose

cave, once also oracular, was upon a summit of the mountain. Their dwellings had generally a well or spring of water, the former being often a collection of moisture condensed or exuding from the roof and sides; and this, in many instances, being pregnant with stony particles, concreted and marked its passage by incrustation, the groundwork, in all ages and countries, of idle tales framed or adopted by superstitious and credulous people.

"A cave in Paphlagonia was sacred to the nymphs who inhabited the mountains about Heraclea. It was long and wide, and pervaded by cold water clear as crystal. There also were seen bowls of stone, and nymphs and their webs and distaffs, and curious work, exciting admiration. The poet who has described this grotto does not deserve to be regarded as servilely copying Homer; he may justly lay claim to rank as an original topographer.

"The piety of Archidamus furnished a retreat for the nymphs, where they might find shelter and provision, if distressed; whether the sun parched up their trees, or Jupiter, enthroned in clouds upon the mountain top, scared them with his red lightning and terrible thunder, pouring down a deluge of rain, or brightening the summits with his snow."

NYMPH, amongst naturalists, that state of winged insects between their living in the form of a worm and their appearing in the winged or more perfect state. See ENTOMOLOGY.

NYMPHÆA, amongst the ancients, certain structures, although it is doubtful of what kind they were. Some take them to have been grottoes, deriving their name from the statues of the nymphs with which they were adorned; but that they were considerable works, appears from their having been executed by the emperors, or by the city prefects. In an inscription, the term is written *nymfium*. None of all these *nymphæa* has remained till our time. A number of years ago, indeed, a square building of marble was discovered between Naples and Vesuvius, with only one entrance, and some steps leading down to it. On the right hand as you enter, towards the head, there is a fountain of the purest water, along which, by way of guardian, is placed a naked Arethusa of the whitest marble. The bottom or ground is of variegated marble, and encompassed with a canal fed by the water from the fountain. The walls are set round with shells and pebbles of various colours, by which are expressed the twelve months of the year, and the four political virtues, as also the rape of Proserpine; Pan playing on his reed, and soothing his flock; and the representations of nymphs swimming, sailing, and wantoning on fishes. It seems pretty evident that the *nymphæa* were public baths; for at the same time that they were furnished with pleasing grottoes, they were also supplied with cooling streams, by which they were rendered exceedingly delightful, and drew great numbers of people to frequent them. Silence seems to have been a particular requisite in these retreats, as appears by this inscription, *Nymphis loci, bibe, lava, tace.* The building between Naples and Vesuvius, mentioned above, was certainly one of these *nymphæa*.

NYSA, or NYSSA, in *Ancient Geography*, a town of Ethiopia, to the south of Egypt. Some place it in Arabia. This city, with another of the same name in India, was sacred to the god Bacchus, who was supposed to have been educated there by the nymphs of the place, and who received the name of *Dionysus*, which seems to be compounded of Διος and Νυσα, the name of his father, and that of the place of his education. The god is believed to have made this place the seat of his empire, and the capital of the conquered nations of the East. According to some geographers, there were no less than ten places of this name.

O.

O || Oak.

O, THE fourteenth letter and fourth vowel of our alphabet, being pronounced as in the words *nose, rose, hose.* The sound of this letter is often so soft as to require it double, and that chiefly in the middle of words, as *goose, reproof, woof;* and in some words this double *oo* is pronounced like *u* short, as in *blood, flood.* As a numeral, O was sometimes used for 11 amongst the ancients, and with a dash over it, thus, Ō, it stood for 11,000. In the notes of the ancients, O. CON. is read *opus conductum;* O. C. Q. *opera consilioque;* O. D. M. *operæ donum munus;* and O. LO. *opus locatum.* The Greeks had two O's, namely, the omikron, ο, and the omega, ω; the one being pronounced on the tip of the lips with a sharper sound, and the other in the middle of the mouth, with a fuller sound, equal to *oo* in our language. The long and short pronunciations of our O are equivalent to the two Greek ones. O is usually denoted as long by a servile *a* subjoined, as *moan;* or by *e* at the end of the syllable, as *bone;* but when these vowels are not used it is generally short. Amongst the Irish, the letter O, at the beginning of the name of a family, is a character of dignity annexed to great houses. Thus, in the history of Ireland, we frequently meet with the *O'Neals, O'Carrols,* and *O'Connells,* considerable personages in that island. Indeed Campden observes, that it is the custom of the lords of Ireland to prefix an O to their names, to distinguish them from the commonalty. The ancients used O as a mark of triple time, from a notion that the ternary, or number 3, was the most perfect of numbers, and therefore properly expressed by a circle, which is the most perfect of figures. It is not, strictly speaking, the letter O, but the figure of a circle O, or double CO, by which the early moderns used to express in music what they called *tempo perfecto,* or triple time; and hence the Italians call it *circolo.* The seven antiphones, or alternate hymns of seven verses, sung by the choir in the time of Advent, were formerly called O, from their beginning with such an exclamation.

O, or OH, is an adverb of calling, or interjection of sorrow or wishing.

OAK. The oak has long been known by the title of "monarch of the woods," and, we may add, justly.

The ancient Druids had a profound veneration for oak trees. Pliny says that "the Druids, as the Gauls call their magicians or wise men, held nothing so sacred as the misletoe, and the tree on which it grows, provided it be an oak. They make choice of oak groves in preference to all others, and perform no rites without oak leaves; so that they seem to have the name of Druids from thence, if we derive their name from the Greek."

This useful tree grows to such surprising magnitude, that were there not many well-authenticated instances in our own country, it would certainly appear difficult to believe that it could attain such size. In the eighteenth volume of the Gentleman's Magazine we have the dimensions of a leaf twelve inches in length and seven in breadth; and all the leaves of the same tree were equally large. On the estate of Woodhall, purchased in 1775 by Sir Thomas Rumbold, an oak was felled which sold for L.43, and measured twenty-four feet in circumference. We are also told of one in Millwood Forest, near Chaddesley, which was in full verdure in winter, getting its leaves again, after the autumnal ones fell off. In Evelyn's *Sylva,* we have an account of a very remarkable oak at Greendale, which Gough, in his edition of Campden, thus minutely describes: "The Greendale oak, with a road cut through it, still bears one green branch. Such branches as have been cut or broken off are guarded from wet by lead. The diameter of this tree at the top, whence the branches issue, is fourteen feet two inches; at the surface of the ground eleven feet and a half, circumference there thirty-five feet; height of the trunk fifty-three; height of the arch ten, width six. Mr Evelyn mentions several more oaks of extraordinary size in Worksop Park."

M. Hamel du Monçeau, a member of the Royal Academy of Sciences at Paris, gave an account, in the year 1749, of an oak which he had kept in water eight years, and which yielded fine leaves every spring. The tree, he says, had four or five branches; the largest nineteen or twenty lines round, and more than eighteen inches in length. It throve more in the first two years than it would have done in the best earth; but it afterwards lost its vigour, and rather decayed, which he attributed more to a defect in the roots than to a want of aliment.

Buffon made some experiments upon oak trees, the result of which is recorded in the Gentleman's Magazine, 1754. He had compared barked with unbarked trees, and concluded, from a variety of trials, that timber barked and dried standing, is always heavier and considerably stronger than timber kept in its bark.

The use of oak bark in tanning, and in hot-beds, is generally known. For the latter of these purposes, however, oak leaves are now found to answer equally well, or rather better. In the notes to Dr Hunter's edition of Evelyn's Treatise on Forest Trees, we find certain directions for their use, by Mr Speechly. The leaves are to be raked up as soon as possible after they fall from the trees. When raked into heaps, they should immediately be carried into some place near the hot-houses, where they may lie to couch. It is the custom of some to fence them round with charcoal hurdles, or any thing to keep them from being blown about the garden in windy weather. They are then trodden well, and watered in case they happen to have been brought in dry. The heap is made six or seven feet thick, and covered over with old mats, or any thing else, to prevent the upper leaves from being blown away. In a few days the heap will attain a strong heat. For the first year or two in which he used these leaves, Mr Speechly did not continue them in the heap longer than ten days or a fortnight; but by this method of management they settle so much when brought to the hot-house, that a supply was very soon required; and he afterwards found, that it was proper to let them remain five or six weeks in the heaps before they were brought to the hot-house. In getting them into the pine pots, if they appear dry, they are to be watered, and again trodden down exceedingly well, in layers, till the pits are quite full. The whole is then covered with tan bark, to the thickness of two inches, and well trodden down, till the surface becomes smooth and even. The pine pots are then to be placed in the manner in which they are to stand, beginning with the middle row first, and filling up the spaces between the pots with tan. In this manner we are to proceed to the next row, till the whole be finished; and the operation is performed in the same manner as when tan only is used. The leaves require no further trouble through the whole season, as they will retain a constant and regular heat during twelve months without stirring or turning; and Mr Speechly informs us, that if he might judge from their appearances when taken out, being always entire and perfect, it was probable they would continue their heat through a second year; but, as an annual supply of leaves is easily obtained, the experiment is hardly worth making. After this, the pines will have no occasion to be moved except at stated times of their management, as at the shifting them in their pots, when at each time a little fresh tan should be added to make up the deficiency arising from the settling of the beds; but this will be inconsiderable, as the leaves do not settle much after their long couching. During the first two years of our author's practice he did not use any tan, but plunged the pine pots into the leaves, and merely covered the surface of the beds, when finished, with a little saw-dust, to give it a neatness. This method, however, was attended with one inconvenience; for, by the caking of the leaves, they shrunk from the sides of the pots, by which they became exposed to the air, and at the same time the heat of the beds was permitted to escape. See Planting.

Oak-Leaf Galls. These are of several kinds. The remarkable species called the *mushroom gall* is never found on any other vegetable substance than these leaves; and, besides this, there is a great number of other kinds.

The double gall of these leaves is very singular, because the generality of productions of this kind affect only one side of a leaf or branch, and grow all one way; whereas this kind of gall extends itself both ways, and is seen upon each side of the leaf, in the form of two protuberances, the one opposite to the other. These are of differently irregular shapes; but their natural figure seems that of two cones, with broad bases and very obtuse points, though they are sometimes round, or very nearly so.

These make their first appearance on the leaf in April, and remain on it till June, or even longer. They are at first green, but afterwards yellowish, and are softer to the touch than many other of the productions of this kind. They are usually about the size of a large pea, but sometimes they grow to the size of a nut. When opened, they are found to be of that kind which is inhabited each by one insect only, and contains but one cavity. The cavity in this, however, is larger than in any other gall of the size, or even in many others of three times its size; the sides of it being very little thicker than the substance of the leaf.

OAKA, a town of Hindustan, in the province of Gujerat, and capital of a district of the same name. It was long the residence of a gang of pirates, who preyed upon the trade and shipping that frequented those seas. They at length received a severe chastisement from the East India Company's marine, and afterwards agreed to respect the British flag. These rude people were accustomed to rely for protection in their piratical adventures upon an idol at the temple of Dwaraca, to which they vowed a large share of the plunder provided they were successful; and they were accordingly instigated to piracy by the priests of the temple, who were large sharers in the booty acquired. The district of Oaka or Oakamundal is situated on the Gulf of Cutch, and separated from the mainland by the swamp called the Runn. The few quiet inhabitants who reside in it breed a number of camels, which browse on the shrubs growing around the swamp; but the greater number of the people are pirates. Long. of the town 69. 36. E. Lat. 22. . N.

OAKHAMPTON, a borough and market town in the county of Devon, and hundred of Lifton, 195 miles from London, and twenty-one from Exeter. There is very little trade in this place, the manufacture of serges having of late years disappeared. The corporation consisted of a mayor, burgesses, a recorder, and eight aldermen. It returned two members to parliament till 1832, but it is now disfranchised. The population amounted in 1801 to 1430, in 1811 to 1440, in 1821 to 1907, and in 1831 to 2055.

OAKINGHAM, or Wokingham, a market-town of the hundred of Sonning, in the county of Berks, but with the singularity, that a part of the town, including the church, is in the hundred of Amesbury, and the county of Wilts. It is thirty-two miles from London, and seven from Reading, and is situated on the border, within the boundary of the royal forest of Windsor. It consists of four streets meeting in the market-place, where is the town-hall. The church is an extensive structure, supported by handsome pillars, and adorned by many monuments. It has a good free school, and some charities, particularly one endowed by Archbishop Laud for female servants. A well-furnished market is held every Tuesday. The number of inhabitants, including the parts of both counties, amounted in 1801 to 2027, in 1811 to 2085, in 1821 to 2490, and in 1831 to 2692.

OANNES, a being in Chaldaic mythology, represented as half a man and half a fish. According to Berosus and other fabulous writers, this monster was the civilizer of the Chaldæans, to whom he is said to have taught a system of jurisprudence so perfect as to be incapable of further improvement. In discharging the duties of his office, he is said to have spent the day on dry land, but to have retired every night into the ocean or the river.

OAR, a long piece of timber, flat at one end and round or square at the other, and which being applied to the side of a floating vessel, serves to propel, or cause it to advance upon the water.

That part of the oar which is out of the vessel, and which enters into the water, is called the *blade* or *wash-plat*; and that which is within board is termed the *loom*, the extremity of which, being small enough to be grasped by the rowers or persons managing the oars, is called the *handle*.

OARISTUS, or Oaristys, a term in Greek poetry, signifying a dialogue between a husband and his wife; as that in the sixth book of the Iliad, between Hector and Andromache. Scaliger observes, that the oaristus is not properly any particular little poem, or entire piece of poetry, but always a part of a great one; and that the passage in Homer here referred to is the only proper oaristus extant in ancient poetry.

OASIS, the name of a fertile spot in the midst of a sandy desert. Many of these spots, or *oases*, in the African deserts, are remarkable for their fertility.

OATH, an affirmation or promise, accompanied with an invocation of God to witness what we say, and with an imprecation of his vengeance, or a renunciation of his grace, if what we affirm be false, or what we promise be not performed. The word is a corruption of the Saxon *eoth*; and in England it is often called a *corporal oath*, because, in the days of Catholicism, the person was sworn upon the host or *corpus Christi*.

The laws of all civilized states have required the security of an oath for evidence given in a court of justice, and on other occasions of high importance; but the Quakers and some other sects refuse to swear on any occasion, even at the requisition of a magistrate, and in a court of justice. The text of Scripture upon which the Quakers principally rest their argument for the unlawfulness of all swearing, is our Saviour's prohibition, "I say unto you, swear not at all." But it is only in ordinary conversation, and by no means in courts of justice, that Christ prohibits his followers from swearing at all. There is no evidence whatever, that swearing by heaven, by the earth, by Jerusalem, or by their own heads, was the form of a judicial oath in use amongst the Jews. On the contrary, we are told by Maimonides, that "if any man swear by heaven or

Oath. by earth, yet this is not an oath;" which, surely, he could not have said had such been the forms of judicial swearing. Indeed the Jews could not have admitted such forms into their courts without expressly violating the law of Moses, who commands them to "Fear Jehovah their God, to serve him, and to swear by his name." But the Jews, as every one knows, had such a reverence for the name of Jehovah, that they would not pronounce it on slight occasions, and therefore could not swear by that name in common conversation. Hence, to gratify their propensity to common swearing, they invented such oaths as, by heaven, by earth, by Jerusalem, by the life of thy head, and such like, and by this contrivance they thought to avoid the guilt of profaning the name of Jehovah. These, however, being appeals to insensible objects, either had no meaning, or were in fact, as our Saviour justly argues, oaths by that God whose creatures they were; so that the Jew who swore them was still guilty of profaneness towards the very Jehovah whose name his superstition would not permit him to pronounce. But what puts it beyond all doubt that the use of judicial oaths is not wholly prohibited in the gospel, is the conduct of our Saviour himself, as well as that of his apostle St Paul. When Jesus was simply asked by the high priests, what it was which certain false witnesses testified against him, we are told by the evangelists, that "he held his peace;" but being adjured by the living God to declare whether he was the Christ, the Son of God, or not, he immediately answered the high priest, without objecting to the oath (for such it was) upon which he was examined. St Paul, in his Epistle to the Romans, says, "*God is my witness*, that, without ceasing, I make mention of you in my prayers;" and to the Corinthians, still more strongly, "*I call God for a record upon my soul*, that, to spare you, I came not as yet to Corinth." Both these expressions are of the nature of oaths; and the author of the Epistle to the Hebrews speaks of the custom of swearing judicially without any mark of censure or disapprobation: "Men verily swear by the greater; and an oath, for confirmation, is to them an end of all strife."

But although a nation has an undoubted right to require the security of an oath upon occasions of real importance, it is something worse than bad policy to multiply oaths, and to hold out to the people temptations to perjure themselves. The security which an oath affords depends entirely upon the reverence which attaches to it in the mind of him by whom it is given; but that reverence is much weakened by the frequency of oaths, and by the careless manner in which they are too often administered. Paley observes, with truth, that "the levity and frequency with which oaths are administered, has brought about a general inadvertency to the obligation of them, which, both in a religious and political view, is much to be lamented; and it merits," continues he, "public consideration, whether the requiring of oaths on so many frivolous occasions, especially in the customs, and in the qualification for petty offices, has any other effect than to make them cheap in the minds of the people. A pound of tea cannot travel regularly from the ship to the consumer without costing half a dozen oaths at least; and the same security for the due discharge of his office, namely, that of an oath, is required from a churchwarden and an archbishop, from a petty constable and the chief justice of England. Let the law continue its own sanctions if they be thought requisite, but let it spare the solemnity of an oath; and where it is necessary, from the want of something better to depend upon, to accept a man's own word or own account, let it annex to prevarication penalties proportioned to the public consequence of the offence."

Besides the frequency of oaths, we have mentioned the irreverent manner in which they are too often administered as one of the causes which make them cheap in the estimation of the people. In this view, the form of the oath, and the ceremonies with which it is required to be taken, are of considerable importance. "The forms of oaths in Christian countries," says Paley, "are very different; but in none, I believe, worse contrived, either to convey the meaning or to impress the obligation of an oath, than in England."

Oaths are either assertory or promissory. Assertory oaths are required both to confirm our veracity in evidence, and to give security to the public, that we believe certain propositions conceived to be of public importance. An oath in evidence binds the juror to declare what he knows to be true, and nothing but what he knows to be true. An oath required to assure the public of our belief in the truth of any proposition cannot, without the guilt of perjury, be taken by any man, who, at the time of swearing, has the slightest doubt in his mind whether the proposition be really true. Such an oath, however, though it unquestionably requires the sincerity of the juror's belief at the time when it is given, cannot oblige him to continue in that belief as long as he may live; for belief is not in any man's power, being the necessary consequence of evidence, which compels the assent of the mind, according as it appears to preponderate on the one side or on the other. No man, therefore, can be justly accused of perjury for holding opinions contrary to those which he may formerly have sworn to believe; because his belief at the time of emitting his oath may have been the necessary result of the evidence which then appeared before him, and his change of opinion may have resulted with the same necessity from superior evidence which had been since then thrown into the opposite scale, and made it preponderate. On this account we cannot help thinking that all assertory oaths, excepting such as are necessary to confirm testimony respecting facts, ought either to be abolished, or expressed with great caution. Of truths intuitively certain, or capable of rigid demonstration, no man of common sense can entertain a doubt; and therefore the public never requires from individuals the solemnity of an oath as an assurance of their believing such truths. But with respect to the truth of propositions which admit of nothing superior to moral evidence upon either side, a man of the most steady virtue may think differently at different periods of his life; and in such cases, the effect of an oath, if it have any effect, can only be either to shut the man's eyes against the light, or to make his integrity be causelessly questioned by those who may observe his change of belief.

Promissory oaths cannot, without the guilt of perjury, be given by him who, at the time of swearing, knows that it will not be in his power to fulfil the promise, or who does not seriously intend to fulfil it. A promissory oath cannot, without great guilt, be given by any man, who at the time of swearing believes the object of the promise to be in itself unlawful; for if he seriously mean to fulfil his oath, he calls upon Almighty God to witness his intention to commit a crime. Promissory oaths give to the public greater security than a simple promise; because the juror having the thoughts of God and of religion more upon his mind at the one time than at the other, offends with a higher hand, and in more open contempt of the divine power, knowledge, and justice, when he violates an oath, than when he breaks a simple promise. Yet it is certain that promissory oaths, though more solemn and sacred, cannot be binding when the promise without an oath would not be so, though in an inferior degree.

OAXACA, one of the states of the republican confederacy of Mexico. See the article MEXICO.

OAXACA, the capital city of a state of the same name in the republic of Mexico. It is built on the site of the ancient Huaxyacac, and bore the name of Antequera at the time of the conquest. Its situation is in a delightful valley, forty miles in length by twenty in breadth, and it lies

230 miles south of the city of Mexico. Oaxaca is built in the form of an oblong square, being nearly two miles by one and a quarter in extent, including the suburbs, which are principally occupied by gardens. It is one of the neatest, cleanest, and most regularly built towns in Mexico. The streets are wide and well paved; and there are a number of squares, the beauty of which is enhanced by the presence in all of them of handsome public fountains. The edifices are constructed of a green stone, which, preserving its colour to perpetuity, gives the city a singular appearance of freshness. The convent of San Francisco, situated in the great square, was erected above two hundred years ago, yet it still retains the appearance of a new building. There are a number of public edifices in Oaxaca, including several churches, which are solidly built, and richly decorated. The climate is considered as unsurpassed for salubrity and equability by any in the republic, the thermometer rarely falling below 63°, nor ranging higher than 78°. The markets are supplied with fruits both of the temperate and torrid zones, raised in the vicinity; and it is no uncommon thing to see trees loaded with oranges on one side of the road, and fields of wheat extending on the other. Oaxaca was formerly more populous than it is at present, having suffered a good deal during the revolutionary struggle; but the inhabitants still amount to about 20,000.

OBA, a town of Persia, in the province of Azerbijan, at the head of a small gulf on the western coast of the Caspian, and on one of the mouths of the Kur, about 150 miles north-east of Tabreez.

OBADIAH, or the *Prophecy* of OBADIAH, a canonical book of the Old Testament, contained in a single chapter. It is partly an invective against the cruelty of the Edomites, who mocked and derided the children of Israel as they passed into captivity, and, with their confederates, invaded and oppressed these strangers, dividing the spoil amongst themselves; and partly a prediction of the deliverance of Israel, and of the victory and triumph which the church would gain over her enemies.

OBAN, a neat and small modern town in the parish of Kilbride, lordship of Lorn, and county of Argyle, ninety-two miles from Glasgow, and 136 from Edinburgh. The situation of the town is well chosen, both as regards the picturesque scenery amidst which it is placed, the convenient station which its bay affords for national purposes, as the dépôt for the trade of the Hebrides and the western coast of the Highlands, and as being admirably designed for a fishing station. The bay of Oban, at the head of which the town lies, is semicircular, being formed by the island of Kerrera in front, and, backed by the huge ranges of the Argyleshire mountains; it is well sheltered from the western winds by the island of Kerrera, varies from twelve to twenty-four fathoms in depth, and is capable of containing from three to five hundred sail of merchantmen. The steamers from Glasgow and Liverpool, which visit the western coast and Inverness by the Crinan and Caledonian Canals, generally stop at Oban; and, from the salubrity of the air, and moderate rate of the markets, it is much resorted to as bathing quarters during the summer months, and many respectable families have now made it their permanent place of residence. The territory of the burgh consists of the lands of Oban and Glenshellich, with the ferry-house, miller's croft, and loch, and the lands of Glencrutten. This territory, however, extends considerably beyond the parliamentary bounds assigned to the town by the burgh reform act. The town is divided by a small river into two divisions, called the eastern and western. In the eastern a handsome church was erected in the year 1821 as a chapel of ease to the parish church, which is at a distance of four miles from the town. It was constituted a port of customs in the year 1763; and the custom-house is pleasantly placed upon a rising situation, so as to command a view of the bay. The superiors and proprietors of the burgh are the Duke of Argyll and Mr Campbell of Combie. These proprietors and their predecessors, as soon as they observed that some trade had begun to be carried on, granted building leases of portions of their lands upon the most liberal terms, and under this system it rapidly increased. Oban was first erected into a burgh of barony in 1811 by the Duke of Argyll, with the consent of Mr Campbell. This charter was, however, laid aside, on grounds arising out of the titles of the Argyll estates; and Mr Campbell having in the mean time acquired the superiority of his lands, a new charter was granted in the year 1820. There are no public buildings belonging to the burgh, nor public institutions of any kind; neither is it possessed of any property or annual revenue, nor encumbered with any amount of debt. The magistrates and council have no power to tax or assess the inhabitants, and no taxes have been imposed; neither have they the right of appointment to any office, civil or ecclesiastical. The exports to Glasgow and Liverpool are cattle, wool, fish, pig iron, and slates brought from the district of Easdale. A weekly market is held in the town, and two annual fairs. The municipal government of the burgh is vested in two bailies and four councillors; and by its charter the burgesses annually elect a dean of guild, a nominal treasurer, and the different officers connected with a burgh court. The burgh returns, with Ayr, Irvine, Campbelton, and Inverary, a member to parliament. The population of Oban amounted in 1831 to 1480.

OBDORSK, a name which is given to that part of Asiatic Russia which extends along the northern part of the course of the Obi to the Frozen Ocean. It is also the name of a small palisadoed fort, the most northerly of any maintained by Russia, being garrisoned by an officer, with twenty-five Cossacks, who exercise a species of sovereign control over the scattered tribes of Ostiaks and Samoyedes.

OBELISK, in *Architecture*, a truncated, quadrangular, and slender pyramid, raised as an ornament, and frequently charged with inscriptions or hieroglyphics.

Obelisks appear to have been of very great antiquity, and first raised to transmit to posterity certain precepts, which were cut in hieroglyphical characters; but they were afterwards used to immortalize the great actions of heroes, and the memory of persons who were beloved. The first obelisk mentioned in history was that of Ramesses king of Egypt, which was forty cubits high. Phius, another king of Egypt, raised one of fifty-five cubits; and Ptolemy Philadelphus, another of eighty-eight cubits, in memory of Arsinoe. Augustus erected one at Rome in the Campus Martius, which served to mark the hours on a horizontal dial, drawn upon the pavement. They were called by the Egyptian priests the "fingers of the sun," because they were made in Egypt to serve also as styles or gnomons for marking the hours on the ground. The Arabs still call them "Pharaoh's needles." All the learning on the subject of obeliks will be found accumulated in the elaborate work of Zoëga (*De Origine et Usu Obeliscorum*) printed at Rome, and illustrated with very beautiful and accurate plates, in which the hieroglyphics are represented with great distinctness and accuracy.

OBERGLEICHEN, a city of the grand duchy of Saxe-Gotha, in Germany, in the circle of Volkerode, the capital of a bailiwick of the same name. It is situated on the river Ohre, in the Thuringen Forest, and is the property of Prince Hohenlohe of Neuenstein, now mediatized. It contains four churches, two hospitals, 860 houses, and 3640 inhabitants, who carry on various manufactures, especially those of woollen, iron, and copper. Lat. 50. 50. 33. N.

OBERNAY, or OBEREHINHEIM, a town of the department of the Lower Rhine, and the arrondissement of Schletstadt, in France. It stands on the river Ergers, upon the side of the mountain Odilienberg, and contains 4480 inhabitants, who carry on a great trade as coppersmiths and bell-founders.

OBERNIK, a town of the Prussian government of Posen, the capital of a circle of the same name, which contains four towns and 109 villages, with 32,200 inhabitants. It stands on the river Warthe, at its junction with the Welna, and contains 1200 inhabitants, of whom more than one third are Jews. It has some linen weaving.

OBERZO, a city of Austrian Italy, in the province of Milan and delegation of Treviso. It was the *Opitergum* of Strabo, and formerly stood on the sea, but is now some miles from it. It is fortified, and contains 730 houses, with 4560 inhabitants. Long. 12. 24. 49. E. Lat. 45. 46. 23. N.

OBI, a great river of Asiatic Russia, which is said to rise in fifty-two degrees of north latitude, on the southern side of the Altai Mountains, from a lake called by the Tartars Altyn Noor. It is now denominated By, and was formerly known by the name of the Great River, as being the longest which flows through Asiatic Russia. It receives the waters of the Irtysch, after which it becomes very broad, and sometimes extends several miles across. It also spreads out into branches, which again re-unite and form numerous islands. It flows through the governments of Kolivan, Tobolsk, Tomsk, and Narym. The entire length of its stream is two thousand miles; yet, from the northerly course which it takes into the barren and inhospitable regions of Northern Asia, it is comparatively of much less benefit in facilitating the internal communications of the country than if it flowed east and west, as it only gives access to countries cold, unproductive, and barbarous, which mankind would rather desire to fly from than to visit. It abounds, however, in fish, which might become a lucrative object of trade, as during the summer season they might be sent along the Northern Ocean to Archangel.

OBIDOS, a town of Portugal, in the province of Estremadura, and the corregimento of Alenquer. It is situated near the sea coast, on an inlet which forms a small lake called the Lago de Obidos, and contains 1090 houses, but not much more than 3500 inhabitants. On a hill adjoining are the ruins of an ancient castle. A battle was fought at this place by a part of the Duke of Wellington's army, previous to the conflict of Vimiera, in August 1808. It is about forty-five miles north of Lisbon.

OBJECT, in *Philosophy*, is something apprehended or presented to the mind by sensation or imagination. See METAPHYSICS.

OBJECTIVE, is a term used in the schools, in speaking of a thing which exists no otherwise than as an object known. The existence of such a thing is said to be objective.

OBIT signifies a funeral solemnity, or office for the dead, most commonly performed when the corpse lies in the church uninterred; and also the anniversary office. The anniversary of any person's death was called the *obit;* and to observe such day with prayers and alms, or other commemoration, was the keeping of the obit. In religious houses they had a register, in which they entered the obits or obitual days of their founders and benefactors, and which was thence termed the *obituary*. The tenure of obit or chantry lands was taken away and extinguished by 1 Edw. VI. c. 14, and 15 Car. II. c. 9.

OBLATE, flattened or shortened, as an oblate spheroid, having its axis shorter than its middle diameter, and being formed by the rotation of an ellipse about its shorter axis. The earth, the polar diameter of which is shorter than the equatorial, is an oblate spheroid.

OBLATI, in church history, were secular persons, who devoted themselves and their estates to some monastery, into which they were admitted as a kind of lay-brothers. The form of their admission was putting the bell-ropes of the church round their necks, as a mark of servitude. They wore a religious habit, which, however, was different from that of the monks.

OBLIGATION, in general, denotes any act by which a person becomes bound to another to do something, as to pay a sum of money, be surety, or the like. Obligations are of three kinds; natural, civil, and mixed. Natural obligations are entirely founded on natural equity; civil obligations rest on civil authority alone, without any necessary foundation in natural equity; and mixed obligations are those which, being founded on natural equity, are besides enforced by civil authority.

In a legal sense, obligation signifies a bond, in which is contained a penalty, with a condition annexed, for the payment of money, or the performance of some act. The difference between it and a bill is, that the latter is generally without a penalty or condition, though it may be made obligatory; and obligations are sometimes incurred by matter of record, as statutes and recognizances.

OBLIQUE, in *Geometry*, something aslant, or which deviates from the perpendicular. Thus an oblique angle is either an acute or obtuse one, that is, any angle except a right one.

OBLIQUE *Cases*, in *Grammar*, are all the cases of nouns except the nominative.

OBLIQUE *Ascension* is that point of the equinoctial which rises with the centre of the sun, or star, or any other point of the heavens, in an oblique sphere.

OBLIQUE *Circle*, in the stereographic projection, is any circle which is oblique to the plane of projection.

OBLIQUE *Descension*, that point of the equinoctial which sets with the centre of the sun, or star, or any other point of the heavens, in an oblique sphere.

OBLIQUE *Line*, that which, falling on another line, makes oblique angles with it; that is, the one acute, and the other obtuse.

OBLIQUE *Planes*, in *Dialling*, are those which decline from the zenith, or incline towards the horizon.

OBLIQUE *Sailing*, in *Navigation*, is when a ship sails upon some rhumb between the four cardinal points, making an oblique angle with the meridian; in which case she continually changes both latitude and longitude.

OBLIQUUS, in *Anatomy*, a name given to several muscles, particularly in the head, eyes, and abdomen.

OBLONG, in general, denotes a figure the length of which exceeds the breadth; as, for example, a parallelogram.

OBOLUS, an ancient silver money of Athens, the sixth part of a drachma, and worth somewhat more than a penny farthing sterling.

OBOLUS, in *Medicine*, is used to signify a weight of ten grains, or half a scruple.

OBOJAN, a city of Russia, in the government of Kursk, the capital of a circle of the same name. It stands at the mouth of the Obojanta, where that river falls into the Psol, and contains 430 dwelling-houses, with 5500 inhabitants, all trading in the products of the vicinity. It is 756 miles from St Petersburg. Long. 35. 45. E. Lat. 51. 12. N.

OBREPTITIOUS, an appellation given to letters patent, or other instruments, obtained of a superior by surprise, or by concealing from him the truth.

OBSCAIA, a gulf of the Frozen Ocean, on the southern coast of Asiatic Russia, and forming the estuary of the great river Obi. It extends from lat. 66. 40. to 72. 15. N. and from long. 72. to 76. E.

OBSCURE, something that is dark, and reflects little light on material objects, or that is not clear and intelligible in the objects of the intellect.

OBSECRATION, in *Rhetoric*, a figure by which the orator implores the assistance of God or man.

OBSERVATION ISLAND, a small island on the north coast of New Holland, in the Gulf of Carpentaria, on the west shore, and one of Sir Edward Pellew's group.

OBSERVATORY, a place destined for observing the heavenly bodies, being generally a building erected upon some eminence, covered with a terrace for making astronomical observations. There are many such buildings; but the more celebrated are, the Greenwich observatory, built in 1676, by order of Charles II. at the solicitation of Sir Jonas Moore and Sir Christopher Wren, and furnished with accurate instruments; the Paris observatory, built by the order of Louis XIV. in the fauxbourg St Jacques; and Tycho Brahe's observatory, which was situated in the little island of Ween, between the coasts of Schonen and Zealand, in the Baltic. This last was crected and furnished with instruments at the expense of Tycho, and called by him Uraniburg. Here he spent twenty years in observing the stars, the result of which was his catalogue. Pekin observatory Le Compte describes as a magnificent establishment, having been erected and furnished at the intercession of some Jesuit missionaries, principally Verbeist. Of the observatory at Benares, Sir Robert Barker gives a very full account in the Philosophical Transactions (vol. lxvii. p. 598).

OBSERVATORY ISLAND, or PADEVOUA, a small island in the South Pacific Ocean, near the north-east coast of New Caledonia. Long. 165. 41. E. Lat. 20. 18. S.

OBSIDIONALIS, an epithet applied by the Romans to a sort of crown, conferred on those who had distinguished themselves in the attack of fortified places.

OBY, or OUBY, a small island in the Eastern Seas, fifty miles long, and from twelve to twenty broad. The sovereignty of this island is claimed by the sultan of Bachian, who has a pearl fishery on its coasts. On this island live many runaway slaves, who cultivate cloves, which they sell to the Buggesses. The Dutch have a small fort on the western side of the island. Long. 124. 56. E. Lat. 1. 36. S. Little Oby is a small island near the west coast of the above island. Long. 127. 12. E. Lat. 1. 26. S.

OCANA, a town of Spain, in the province of Toledo, the capital of a partida of the same name, about thirty miles to the south-east of Madrid. It stands on a fertile plain, and is surrounded with an ancient and now a dilapidated wall, the buildings bearing more marks of antiquity than of beauty. It has four churches and eleven religious houses, and is adorned with two fountains, one of them of great beauty. The actual population does not much exceed 5000 persons, and the only occupations, besides that of cultivating the surrounding land, consist in making soap, tanning leather, and making a few silk goods. This place has been rendered remarkable by the great battle fought there in November 1809, when the Spanish army of 50,000 was defeated and dispersed by a French force of considerably less than half that number.

OCCIDENT, in *Geography*, the westward quarter of the horizon, or that part of the horizon where the ecliptic, or the sun therein, descends into the lower hemisphere. It it used in contradistinction to *orient*. Hence the word *occidental* signifies any thing belonging to the west; as occidental bezoar, occidental pearl, and the like.

OCCIDENT *Estival*, that point of the horizon where the sun sets at midwinter, when entering the sign Capricorn.

OCCIDENT *Equinoctial*, that point of the horizon where the sun sets when he crosses the equinoctial, or enters the sign of Aries or of Libra.

OCCIPITAL, in *Anatomy*, a term applied to the parts of the occiput, or posterior part of the skull.

OCCULT, something hidden, secret, or invisible. The occult sciences are magic, necromancy, and some others. Occult qualities, in philosophy, were those qualities of body or spirit which baffled the investigation of philosophers, and for which they were unable to give any reason. Unwilling, however, to acknowledge their ignorance, they deceived themselves and the vulgar by an empty title, calling what they did not know *occult*.

OCCULT, in *Geometry*, is used to signify a line that is scarcely perceptible, drawn with the point of the compasses or a leaden pencil. These lines are used in several operations, as the raising of plans, designs of building, and pieces of perspective; and they are to be effaced when the work is finished.

OCCULTATION, in *Astronomy*, the time during which a star or planet is hid from our sight, by the interposition of the body of the moon or some other planet.

OCCUPANCY, in *Law*, is the taking possession of those things which before belonged to nobody. This, according to Blackstone, is the true ground and foundation of all property, or of holding those things in severalty, which by the law of nature, unqualified by that of society, were common to all mankind.

OCEAN, the vast mass of salt water which encompasses all parts of the globe, and by means of which, in the present improved state of navigation, an easy intercourse subsists between places the most distant. The ocean is distinguished into three grand divisions; the Atlantic Ocean, which divides Europe and Africa from America, and is generally about three thousand miles wide; the Pacific Ocean, or South Sea, which divides America from Asia, and is generally about ten thousand miles over; and the Indian Ocean, which separates the East Indies from Africa, and is three thousand miles across. The other seas which are called *oceans* are only parts or branches of these, and usually receive their names from the countries which they border on. See PHYSICAL GEOGRAPHY.

OCEANIDES, in fabulous history, sea-nymphs, daughters of Oceanus, from whom they received their names, and of the goddess Tethys or Thetis.

OCEANUS, in pagan mythology, the son of Cœlus and Terra, the husband of Thetis, and the father of the rivers and fountains. The ancients called him the "father of all things," imagining that he was produced by Humidity, which, according to Thales, was the first principle whence every thing was produced. Homer describes Juno as visiting him at the remotest limits of the earth, and acknowledging him and Thetis as the parents of the gods. He was represented with a bull's head, as an emblem of the rage and bellowing of the ocean when agitated by storms or tempests.

OCELLUS *the* LUCANIAN, an ancient Greek philosopher of the school of Pythagoras, who lived before Plato. His work περι του Παντος, or the Universe, is the only production of his which has come down entire to us; it was written originally in the Doric dialect, but has been translated by another hand into the Attic. William Christian, and after him Louis Nogarola, translated this work into Latin; and there are several editions of it, both in Greek and in Latin.

OCHLOCRACY, that form of government in which the populace have the chief administration of affairs.

OCHRIDA, a town of Greece, in the province of Albania, the capital of a district of the same name, which it has derived from a lake near it, known to the ancients as the Lychnidus. It is situated on the declivity of Mount Maniana Petrin, on the great road formerly leading from Pella to Dyracchium; and near to it runs the river Drino. The inhabitants are descended from a Bulgarian colony, and they adhere to the Greek church, of which religion there is an archbishop in this place. In the vicinity there are mines of sulphur and of silver, the working of which forms the chief occupation of the population, which amounts to about 4500 persons.

OCHUS, a king of Persia, and son of Artaxerxes. He was cruel and avaricious, and, in order to strengthen himself on his throne, murdered all his brothers and sisters. His subjects revolted; but he reduced them to obedience, and added Egypt to his other dominions. Bagoas, his favourite eunuch, poisoned him for the insults which he had offered to Apis, the god of the Egyptians, gave his flesh to be eaten by cats, and caused handles for knives to be made with his bones.

OCKLEY, SIMON, an eminent orientalist, and professor of Arabic in Cambridge, was born at Exeter in 1678. He was educated at Cambridge, and distinguished himself by uncommon skill in the oriental languages. Having taken a degree in divinity, he was, in 1705, presented by Jesus College with the vicarage of Swavesey, and in 1711 he was chosen Arabic professor of the university. He had a large family, and his latter days were rendered unhappy by pecuniary embarrassments. He died in the year 1720. The principal works of Ockley are, 1. Introductio ad Linguas Orientales, a small volume; 2. The History of the Jews throughout the World, from the Italian of Leo Modena; 3. The Improvement of Human Reason, from the Arabic; 4. The History of the Saracens, in 2 vols. 8vo. This last work is justly valued for its accuracy and erudition.

OCKZAKOFF, or OCZAKOW, a city, once of great importance and much historical interest, in European Russia, belonging to the government of Cherson. It stood on the Black Sea, and, from its commanding the navigation of the rivers Bug and Dnieper, it was strongly fortified by the Turks, and considered as an important barrier against the advancing progress of the Russians in that portion of their territory. The citadel connected with the town was of prodigious strength, and surrounded with a wall twenty-five feet in height. It was, however, unable to resist the military force with which the Russians attacked it in 1737. The siege was obstinate, but at length it was taken by assault, after a bloody contest, in which the victorious Russians lost more than 18,000 men. In the following year, the Turks, eager to retake the place, advanced with an army of 70,000 men; but they were repulsed with the loss of more than 20,000 of their number. Having accomplished and secured the conquest, the Russians razed the fortifications, and abandoned the spot. The Turks in 1743 constructed once more the works of defence, and maintained a powerful garrison within it till the year 1788, when the Russians again attacked it. The latter, commanded by Suwaroff, besieged it for a long time, and ultimately carried it by storm, with a tremendous loss of life to both armies. By the peace of 1791, the whole district was ceded to Russia, upon which the fortifications were demolished. The establishment of Odessa within thirty miles of Ockzakoff has reduced the place to insignificance; though, from its position on the two navigable rivers, it is favourably situated for commerce, having good anchorage within the bar of the river Bug. Long. 32. 39. 10. E. Lat. 46. 59. 0. N.

OCRA, a viscous vegetable substance well known in the West Indies, where it is used to thicken soup, particularly pepper pot, as well as for other purposes.

OCRISIA, in fabulous history, the wife of Corniculus, and one of the attendants of Tanaquil, the wife of Tarquinius Priscus.

OCTAETERIS, a cycle or term of eight years, in the Grecian chronology, at the conclusion of which three entire lunar months were added. The cycle was in use till Meton's invention of the golden number or cycle of nineteen years.

OCTAGON, or OCTOGON, in *Geometry*, is a figure of eight sides and angles. When all the sides and angles are equal, it is called a regular octagon, or one that may be inscribed in a circle.

OCTAHEDRON, or OCTAEDRON, in *Geometry*, one of the five regular bodies, consisting of eight equal and equilateral triangles.

OCTANT, the eighth part of a circle.

OCTAPLA, in matters of sacred literature, denotes a Polyglot Bible, consisting of eight columns, and as many different versions of the sacred text.

OCTATEUCH, an appellation given to the first eight books of the Old Testament.

OCTAVE, in *Music*. See INTERVAL.

OCTAVIA, the daughter of Caius Octavius, and sister of Augustus Cæsar. She was one of the most illustrious ladies of ancient Rome, being equally conspicuous for virtue and beauty. The death of Marcellus, her son by her first husband Claudius Marcellus, constantly preyed upon her mind, and she died of grief or melancholy, about eleven years before the Christian era. Her brother paid great honours to her memory, and pronounced her funeral oration. The Roman people also showed their respect for her virtues, by wishing to pay her divine honours.

OCTAVIANUS, or OCTAVIUS CÆSAR, was the nephew of Julius Cæsar the dictator, being the son of Accia, his sister, by Octavius, a senator; and he afterwards became emperor of Rome. He was born in the year of the city 691, during the consulship of Cicero. His uncle Julius Cæsar adopted him, and left him the greater part of his fortune. When he was about twenty years of age he was raised to the consulship. His youth and inexperience were ridiculed by his enemies; but notwithstanding this obstacle, his prudence and valour soon silenced all objections. He made war against his opponents on pretence of avenging the assassination of his uncle, and engaged in five civil contests with success, namely, the wars of Mutina, Perusia, Philippi, Sicily, and Actium; the first and last of which were against M. Antony; the second against L. Antony, brother of the triumvir; the third against Brutus and Cassius; and the fourth against Sextus Pompey, son of Pompey the Great. He united his forces with those of Antony at the battle of Philippi; and had he not been supported by the activity and bravery of his colleague, he would doubtless have been totally ruined in that engagement. In his triumvirate with Antony and Lepidus, he obtained the western parts of the Roman empire; and, like his other colleagues, the more firmly to establish his power, he proscribed his enemies and cut them off. The triumvirate lasted for ten years. He had given his sister Octavia in marriage to Antony, to render their alliance more lasting; but when Cleopatra had charmed this unfortunate man, Octavia was repudiated. Augustus immediately took up arms to avenge the wrongs of his sister, but perhaps more from a desire to remove a man whose power and consequence kept him in continual fear and constant dependence. Both parties met at Actium to decide the fate of Rome. Antony was supported by all the power of the East, and Augustus by that of Italy. Cleopatra fled from the battle with sixty ships; and her flight ruined the interest of Antony, who followed her into Egypt. The conqueror soon afterwards proceeded to Egypt, where he besieged Alexandria, and honoured with a magnificent funeral his unfortunate colleague and the celebrated queen, whom the fear of being led in the victor's triumph at Rome had driven to commit suicide. After he had established peace all over the world, he shut the gates of the temple of Janus in the year of the city 753. He twice determined to lay down the supreme power, first immediately after the victory obtained over Antony, and again on account of his ill health; but his two faithful friends Mecænas and Agrippa dissuaded him, and contended that if he did he would leave it a prey to the most powerful, and besides expose himself to the greatest dangers. He died at Nola in the seventy-sixth year of his age, after he had held the sovereign power during fifty-seven years. He married four times, but he was unhappy in all these connexions; and his only daughter Julia disgraced herself and her father by the debauchery and licentiousness of her manners. At his death he recommended his adopted son Tiberius as his successor. He left his fortune partly to him and to Drusus, and made donations to the army and Roman people. The title of Augustus was conferred upon him by the senate after the battle of Actium and the final destruction of the Roman republic. The title continued afterwards, being given to his successors in the empire. Virgil is said to have written his Æneid at the desire of Augustus, whom he represents under the amiable and perfect character of Æneas.

OCTOBER, in *Chronology*, the eighth month of Romulus's year, as the name implies; but the tenth in the calendar of Numa, Julius Cæsar, &c. The senate gave this month the name of *Faustinus*, in compliment to Faustina, the wife of the Emperor Antoninus; Commodus wished it to be called *Invictus;* and Domitian named it *Domitianus;* but in spite of all these attempts it still retains its original name. This month was sacred to Mars, and under his protection.

October *Equus*, a horse annually sacrificed to Mars in the month of October, either because the horse is a warlike animal, or in order to punish him for the taking of Troy. A race was run with chariots, drawn by two horses, previously to the sacrifices, and he that ran fastest was adjudged to be the victim.

OCTOSTYLE, in the ancient architecture, is the face of an edifice adorned with eight columns.

ODDLY Odd. A number is said to be oddly odd when an odd number measures it by an odd number. Thus 15 is a number oddly odd, because the odd number 3 measures it by the odd number 5.

ODE, in *Poetry*, is a song or composition proper to be sung.

ODENATUS, a celebrated prince of Palmyra, who very early inured himself to bear fatigues, and, by hunting leopards and wild beasts, accustomed himself to the labours of a military life. He was a faithful friend to the Romans; and when Aurelian had been taken prisoner by Sapor king of Persia, Odenatus warmly interested himself in his cause, and solicited his release, by writing to the conqueror, and by sending him presents. The king of Persia was offended at this liberty of Odenatus; he tore the letter, and ordered the presents which were offered to be thrown into a river; and to punish Odenatus, who had the impudence, as he called it, to pay homage to so great a monarch as himself, he commanded him to appear before him, on pain of being devoted to instant destruction with all his family if he dared to refuse. But Odenatus despised the haughty summons of Sapor, and opposing force by force, obtained some considerable advantages over the troops of the Persian king, took his wife prisoner, and, besides, obtained a great and rich booty. These services were observed with gratitude by the Romans; and Gallienus, then emperor, named Odenatus his colleague on the throne, and gave the title of Augustus to his children, and to his wife the celebrated Zenobia. Odenatus, invested with new power, resolved to signalize himself more conspicuously, by conquering the barbarians of the north; but he perished by the dagger of one of his own relations, whom he had slightly offended at a domestic entertainment. He died at Emessa, about the 267th year of the Christian era. Zenobia succeeded to his titles and honours.

ODENSEE, a city of Denmark, the capital of the island of Funen. It is situated on a canal connecting it with a lake, and in connection with the sea in the Gulf of Stegestrand. It is tolerably built, with good streets, and has a cathedral and seven other churches. It contains about 800 houses, with 6500 inhabitants, who are chiefly engaged in internal trade. Long. 11. 20. 4. E. Lat. 55. 23. 35. N.

ODER, a river of Germany, which has its source near a town of the same name in Silesia, and upon the confines of Moravia. It runs northward through that province, and then into the marche of Brandenburg and Pomerania, where it forms a large lake, and afterwards falls into the Baltic Sea by three mouths, between which lie the islands of Usedom and Wolin. It passes by several towns, as Ratibor, Oppeln, Breslau, Glogau, and Grossen, in Silesia; Francfort, Lebus, and Custrin, in Brandenburg; and Gartz, Stettin, Cammin, Wallin, Usedom, and Wolgast, in Pomerania.

ODESSA, a city of Russia in Europe, within the circle of Tiraspol, in the government of Cherson. It owes its present state, and the rapid advance it has made, to its position on the north-western shore of the Black Sea, between the mouths of two great rivers, the Dniester and the Dnieper, and being not more than twenty-four miles from the Bug, which is navigable from Poland.

From the reign of Peter the Great, Russia had been steadily looking forward to a maritime preponderance, both military and commercial, on the Black Sea; and soon after the peace of Oczakow, by which the province of Cherson was ceded to Catharine, that princess selected as the place for a commercial emporium a village called Kodschabey, then inhabited only by a few fishermen. At first several regiments were marched to the spot, and the erections of public buildings commenced. The first civil settlers were a number of Greek families, who were induced to remove thither from other portions of the country which had been recently given up by the Turks. When the Emperor Alexander ascended the throne, he entered with zeal into the project which Catharine had formed. The French emigrant Duke of Richelieu, who had entered the Russian service, was appointed governor, and displayed great zeal and judgment. By an imperial ukase, all taxes were suspended for sixty years; in consequence of which a considerable number of persons were induced to fix themselves in Odessa, so that by the year 1804 the inhabitants had increased to 15,000. With the progress of population that of public buildings kept pace. A fortress, a lighthouse, and a lazaretto, were constructed, as well as a mole to secure 300 sail of vessels from the south-west winds, which sometimes blow with prodigious force. The war between Russia and Turkey, which was terminated by the general European peace on the capture of Paris, had impeded till that event the growth of the city; but soon afterwards the port of Odessa was declared to be an open one. All goods of every kind could be imported without duty for the consumption of the city, or for re-exportation, but were chargeable with duty on passing into the surrounding country. This gave a great impetus to its advancement, which still operates, till the population has increased to nearly 50,000 persons. The inhabitants, as is natural in new settlements, are of very mixed races. The chief part of them consists of Russians, Greeks, and Jews; but German handicraftsmen are found amongst them in considerable numbers, whilst the more extensive mercantile houses are composed of Italians, English, French, or Armenians. In no spot perhaps in Europe are there so great a number of languages spoken as on the exchange of Odessa. The admixture of oriental dresses, manners, and languages, presents a very novel and lively picture. A stranger might imagine himself translated into one of the trading towns of the Levant; for the bazaars contain all the productions of the East, from Persian shawls down to rose-pastilles; and the Italian language is universally understood.

The prosperity of Odessa has risen in a great measure from its maritime accessibility. It has a spacious bay, Odessa. which, though open to the easterly winds, is tolerably secure; it is very extensive, and the anchorage ground is good. There is a kind of harbour formed by two moles, about two thirds of a mile in length, and a handsome quay capable of receiving vessels of 500 tons burden. The situation of the town on the shore, the land rising very gradually, gives it a good appearance on approaching it from the sea. Like most new places, it is regularly built; the streets are wide and straight, crossing each other at right angles; and the houses are for the most part built of stone, and two stories in height. The streets are however unpaved, and consequently in rainy weather present a mass of mud and dirt; and, on the other hand, when the weather is dry, the clouds of sand which arise prove a terrible annoyance. The place is defended by a strong citadel on the north-east, which has a double ditch, and also several outworks. The walls that surround the city are of more use in a financial than a military point of view. Amongst the public edifices, the most conspicuous is the cathedral, a large and elegant pile. There are eight other churches for the Greek worship, some belonging to the orthodox faith, and others to schismatics. The Jews, Roman Catholics, and German Lutherans, have their respective places of worship. A college has been established, with a museum and botanic garden. There is a large hospital, an assembly room, and a theatre, where plays are performed alternately in the Russian and Greek language, and which is sometimes used for the performance of Italian operas. There are several institutions for educating the poorer classes of both sexes; those for females being under the superintendence of the wife of the governor of the province, who resides here. Most of the water is brackish, and to provide that necessary element in purity, an aqueduct has been constructed, at an expense of more than a million roubles, which conveys it from a distance of nearly twenty miles. All the absolute necessaries of life are remarkably cheap, as must be the case where a single town draws its supplies from a vast and fruitful plain like that which surrounds this city on the land side.

As the rapid growth of Odessa, and the prospect of its continued and increasing extent, depend wholly upon its commerce, it is desirable to take a view of the sources of that commerce. These are to be found in the fertility of its surrounding soil, and that of the more distant districts, to which there is easy access. The steppes, which form a semicircle around Odessa, being the *Sors Deserta* of the ancients, extend to nearly 100 miles from the city. This district is destitute of trees and of water, but the soil is said to be favourable to the growth of corn, especially of wheat. From February to May the growth of grass is most luxuriant, so that it is said to become so high as to hide the cattle; but in the latter month it begins to wither, and in the summer the land is so totally deprived of all verdure, as to present the picture of a dry sand-bank on the sea-shore. The first rains of autumn cause vegetation to shoot forth again with rapidity, till it is checked by the sharp frosts, sometimes of November, but more commonly of December. The slight attempts which have been made to cultivate this portion of land have for the most part been abandoned, and the labour of the residents has been chiefly applied to the feeding and propagating of sheep, and that more for the sake of the wool than of the flesh.

It is from districts bordering upon the northern side of the steppes that the land is to be found, the soil of which, even with the negligent husbandry it receives, is the most abundantly productive of wheat. Whether from the climate or the soil, or from the combination of both, or from other causes of which we are ignorant, there is no part of the world known in which, in propitious seasons, the increase of that grain is so great It is, however, liable to great variations in its growth, and sometimes years occur when the increase is very insignificant.

There are two kinds of wheat cultivated in the district, distinguished by the properties of the hardness or the softness of the grain. They are both white. The hard wheat is most proper for the countries bordered by the Mediterranean Sea, where it is not ground in mills, but is pounded in mortars, and used as food under the names of macaroni, vermicelli, and other similar preparations, which are eaten in those countries as a substitute for bread. The soft wheat comes from the most distant parts. It is the same as that grown in Poland, and brought to England sometimes by way of Dantzic, and occasionally by way of Odessa, and is, by grinding, converted into excellent flour. The hard wheat is sown in the spring of the year, and ripens almost as speedily as barley. The soft wheat is sown in October or November, before the frost sets in, and both ripen nearly together. The extent sown is in some measure regulated by the intelligence received of the productiveness of the preceding harvest in the several countries of Europe. If an extensive failure in the west of Europe is known to have occurred, the intelligence must arrive too late for any great extent of additional land being sown with winter or soft wheat; but as soon as the frost ceases, great activity in the labours of the field is applied to the preparation of the land, for the reception of the seed of spring or hard wheat. Thus the proportion which the two kinds of wheat bear to each other varies with the state of the annual product in those remote countries which draw their supplies from the Black Sea.

The greater portion of the wheat comes from a distance of 200 miles, some of it 250 miles; and in years when the demand is very great, a portion is brought even a distance of 400. A part of it is sent by the growers, or by merchants who have purchased of them, to be sold by the commission-houses in Odessa; but in some seasons large contracts are entered into for the wheat by Odessa merchants at a fair, to which sellers and buyers resort in great numbers, and which is held at the city of Kiew, from the 15th to the 25th of January in each year. The contracts are made for the corn to be delivered on shipboard by the sellers at their own expense, and the money to be paid on delivery; but it has occurred, in seasons when a very great demand was expected, as in 1817, that money has been advanced beforehand on the credit of the future delivery.

The wheat is brought in small waggons, drawn by two bullocks, and the number arriving in Odessa in one day has sometimes amounted to 500 or 600, and in several instances to 1000. Each of these waggons conveys eight sacks of wheat, and the whole load is three quarters and a half, weighing about 1700 pounds. They are dragged along at the rate of about ten miles a day. Though the cattle are grazed free of expense, on the pasture-land on the way, except over the steppes, where, in the months from May to July, the greatest periods of shipment, there are no vestiges of vegetation, the expense is still so considerable, that it has been often found to amount, when the prices have been low, to as much, and in some instances to even more, than the load would sell for at Odessa; and that, too, although the value of a day's labour for a man and two bullocks is only sixpence in Podolia, the province from which most of the wheat is brought.

The wheat is not dried before shipping at Odessa, as is done at Dantzic, and is, therefore, not well calculated for a long sea voyage, when, from heating, it becomes spoiled This has been the case with cargoes sent to London, where, on its arrival, the grain has so run together as to be utterly unfit for food, and has been dug out with pick-axes and thrown into the Thames. The principal portion of the wheat from Odessa is sent thence to Constantinople, Malta, and the ports of Italy, France, and other dépôts in the Mediterranean. It is there often a substitute for wheat grown near them; and when this grain is scarce in England, and other distant markets, the produce of their own harvests is exported. The following table will show the fluctuations in the exports.

An Account of the Quantities of Wheat exported from Odessa in each Year from 1814 to 1836, *from consular returns.*

1814	187,685 quarters.
1815	372,309 ...
1816	801,591 ...
1817	870,893 ...
1818	538,513 ...
1819	627,926 ...
1820	534,199 ...
1821	435,305 ...
1822	342,752 ...
1823	443,035 ...
1824	427,767 ...
1825	170,370 ...
1826	Little or no demand, freights high, and no ships to be had.
1827	No trade in corn; all affairs suspended, from the state of public matters in Constantinople.
1828	Trade suspended by the war with Turkey.
1829	No trade in corn this year.
1830	149,209 quarters. All exported in the last three months of the year, when peace was concluded.
1831	No returns.
1832	401,981 quarters.
1833	101,000 quarters. All exported in the first three months of the year.
1834	45,000 quarters. Crops partially failed.
1835	283,575 ...
1836	452,714 ...

The variations in price during this series of years were excessive. Thus the average price of the year 1825, which was the lowest, was only 13s. 6d. the English quarter; and the average price of the year 1817, which was the highest, was 49s. 11d., being fluctuations to the extent of 375 per cent. The excessive fluctuations in the price, as well as the quantity of the exports, have had a great influence on the prosperity of the city, the chief export consisting of a single article. In the year 1817, the wheat shipped at Odessa was 870,893, at an average of 50s. the quarter, and thus amounting to L.2,177,232. The quantity shipped in 1825 was 170,370, at 13s. 6d. the quarter, thus amounting to no more than L.115,100. It is natural to suppose that a declension in the amount of a single article of exportable produce, to the extent of more than nineteen parts in twenty of its value, must have caused a great convulsion amongst the mercantile establishments at Odessa; and accordingly, in the eight years from 1817 to 1825, almost the whole of them were reduced to a state of insolvency. As regards the producers of the article in question, they too suffered severely. The high prices obtained in 1816 and 1817 gave an impulse to agriculture, which induced the proprietors of land to apply to its cultivation whatever capital they could obtain, either by their own credit, or by mortgaging their estates. The latter was effected with great facility, and to an extent which was severely felt for a long period by the larger proprietors. Many of the small cultivators, who occupied land belonging to the crown, on long leases, with neither rent nor taxes to pay for the first twenty-five years, were induced, by the low prices of wheat, to abandon their holdings, and to repair to the city, where they could obtain employment in the commonest kind of labour, with a better reward than cultivation yielded. Experience has taught the inhabitants the very fluctuating state of the commerce of wheat, and at length many of them have applied their capital and their industry to the cultivation of other articles. The soil is found to be highly favourable to the growth of flax, but more especially to hemp; and large quantities of both are now raised. The breeding of black cattle has also been much extended, and creates a large export of hides and tallow. The tallow shipped increased between the years 1816 and 1831, from the value of 100,000 roubles to that of 2,000,000. Large flocks of sheep have also been reared, and the ancient breeds in many cases have been so effectually crossed by sheep of the Merino race, that much wool of an improved and still improving quality is despatched to Italy, France, England, and Germany. The old commercial houses, who had been ruined by the great depreciation in the price of wheat subsequently to 1817, have been replaced by new firms from Russia, Italy, Germany, France, and England, furnished with ample capital and credit. Some manufactures have been established, which yield a surplus of sail-cloth, cordage, and soap. The value of the exports, since the decline in the wheat trade, has more than doubled during the last ten years. The imports consist for the most part of coffee, sugar, olive-oil, cotton wool, wine, cotton, silk, and woollen goods, timber, coals, fruit, dye-stuffs, tea, and hardware. Odessa has also become a dépôt for an increasing trade with the ports of Asia on the Black Sea.

The number of vessels, and the flags they bore, that entered Odessa in the course of six years, were—

Austrian	953	French	17
Russian	732	Swedish	11
Sardinian	675	Spanish	8
British	598	Dutch	7
Greek	81	Tuscan	3
Turkish	32	American	2
Neapolitan	25		

The tonnage of these is not known; but as the Austrian and Russian vessels must have chiefly consisted of coasters from the ports of these nations within the Black Sea, it is probable they were of much lighter burden than the vessels of the other nations which had come through the Bosphorus. The vessels under the British flag belonged mostly to Malta and the Ionian Islands. The situation of Odessa is in latitude 46. 28. 54. north, and longitude 30. 43. 22. east. The climate is healthy, and the winter, though short, is severe, the sea being more or less frozen for about two months. The summer is intensely hot, but it is deemed salubrious.

ODEUM, in Grecian antiquity, a theatre for music built by Pericles, the inside of which was filled with seats and ranges of pillars, and on the outside the roof descended shelving downwards from a point in the centre, with many bendings, in imitation of the king of Persia's pavilion. Here the musical prizes were contended for; and here, also, according to Aristophanes, there was a tribunal.

ODIHAM, a market-town of the county of Hants, in the hundred of its own name, forty-two miles from London, and twenty-four from Winchester. It has a market, which is held on Saturday, and but little trade except what arises from its wharf on the Basingstoke Canal. A mile from it are the remains of an ancient castle, in which David king of Scotland is said to have been kept a prisoner. The population amounted in 1801 to 1058, in 1811 to 1104, in 1821 to 2423, and in 1831 to 2647.

ODIN, in *Mythology*, called also, in the dialect of the Anglo-Saxons, *Woden* or *Wodan*, a name given by the ancient Scythians to their supreme god, and assumed, about seventy years before the Christian era, by Sigge, a Scythian prince, who conquered the northern nations, made great changes in their government, manners, religion, and had even divine honours paid him. According to the account given of this conqueror by Snorro, the ancient historian of Norway, and his commentator Torfæus, Odin was a Scythian, who withdrew himself by flight, along with many others in his train, from the vengeance of the Romans, under the conduct of Pompey; and having officiated as a priest in his own country, he assumed the direction of the religious worship as well as the civil government of the nations which he had conquered. Having subdued Denmark, Sweden, and Norway, he retired to Sweden, where he died. There is nothing certain in this account; but it is probable that the god whose prophet or priest this Scythian pretended to be, was named Odin, and that the ignorance of succeeding ages confounded the deity with his priest, composing out of the attributes of the one and the history of the other the character of the northern conqueror. He deluded the people by his enchantments and his skill in magic. Having cut off the head of one Mimer, who in his lifetime enjoyed great reputation for wisdom, he caused it to be embalmed, and persuaded the Scandinavians that he had restored it to the use of speech, and caused it to pronounce whatever oracles he wanted. The Icelandic chronicles or sagas represent Odin as the most eloquent and persuasive of men; they ascribe to him the introduction of the art of poetry amongst the Scandinavians, and likewise the invention of the Runic characters. He had also the address to persuade his followers that he could run over the world in the twinkling of an eye; that he had the direction of the air and the tempests; that he could transform himself into all sorts of shapes, raise the dead, foretell things to come, deprive his enemies by enchantment of health and vigour, and discover all the treasures which were concealed in the earth. They add, that by his tender and melodious airs he could make the plains and mountains open and expand with delight; and that the ghosts, thus attracted, would leave their infernal caverns, and stand motionless about him. Nor was he less dreadful and furious in battle; changing himself into the shape of a bear, a wild bull, or a lion, and amidst ranks of enemies committing the most horrid devastation, without receiving any wound in return.

ODOACER, according to Ennodius, was meanly born, and only a private man in the guards of the Emperor Augustulus, when, in the year 476, under the consulship of Basilicus and Armatus, the barbarians chose him for their leader. The barbarians thought that, as they often defended Italy, they had a right to at least part of it; but upon demanding this they were refused, and the consequence was a revolt. Odoacer is said to have been a man of uncommon parts, capable alike of commanding an army or of governing a state. Having left his own country when he was very young, to serve in Italy, he was admitted amongst the emperor's guards, and continued in that station till the above year; when, putting himself at the head of the barbarians in the Roman pay, who, although of different nations, had unanimously chosen him to be their leader, he marched against Orestes, and his son Augustulus, who still refused to share any of the lands in Italy. The Romans were inferior both in numbers and in valour, and were, therefore, easily conquered. Orestes was ordered to be slain; but the Emperor Augustulus was spared, and, although stripped of his dignity, was treated with humanity, and allowed a liberal sum for his own support and for that of his relations. Odoacer was proclaimed king of Italy, but assumed neither the purple nor any other mark of imperial consequence. He was afterwards defeated and slain by Theodoric the Ostrogoth.

ODOMETER, an instrument used for measuring the distance passed over in travelling.

ODOROUS, or ODORIFEROUS, appellations given to whatever smells strongly, whether they be fetid or agreeable, but chiefly to things the smell of which is brisk and pleasant.

ŒCONOMICS, the art of managing the affairs of a family or community; and hence the person who takes care of the revenues and other affairs of churches, monasteries, and the like, is termed *œconomus*.

ŒCUMENICAL signifies the same with *general* or *universal;* as, œcumenical council, bishop, and the like.

OEDENBURG, a city of the Austrian kingdom of Hungary, in the province of the Farther Danube. It is the capital of a circle of the same name (called also Soprony-Barmegye in Hungarian), which extends over 1269 square miles, and comprehends three cities, forty-one market-towns, and 200 villages, with 185,700 inhabitants. It stands on the river Ikva, and is a well-built town, with one Lutheran and two Catholic churches, a monastery and a nunnery, 820 houses, and 12,650 inhabitants, of whom about 5000 are Protestants. It is an industrious place, with manufactures of cotton, woollen, silk, and linen goods, besides glass-houses, sugar refineries, and iron forges; and the neighbourhood yields some good wine. Long. 17. 28. 11. E. Lat. 47. 40. 36. N.

ŒDIPUS, an unfortunate king of Thebes, whose history is partly fabulous. He flourished about 1266 before Christ. It is said he was given by his father to a shepherd, who was ordered to put him to death, in order to prevent the misfortunes with which he was threatened by an oracle. But the shepherd, being unwilling to kill him with his own hands, tied him by the feet to a tree, that he might be devoured by wild beasts. The infant was however found in this situation by another shepherd named Phorbas, who carried him to Polybus king of Corinth, whose queen, having no children, educated him with as much care as if he had been her own son. When he had grown up, he was informed that he was not the son of Polybus; upon which, by order of the oracle, he went to seek for his father in Phocis; but scarcely had he arrived in that country when he met his father on the road, and killed him without knowing him. A short time afterwards, having delivered the country from the monster called the *Sphinx*, he married Jocasta, without knowing that she was his mother, and had four children by her; but afterwards, being informed of his incest, he quitted the throne, and, thinking himself unworthy of the light, put out his eyes. Eteocles and Polynices, both celebrated amongst the Greeks, were the issue of this incestuous marriage.

OEGWA, a town on the Gold Coast of Africa, situated upon the brow of an eminence, which rises by a gentle ascent to a considerable height, and is defended by rocks, against which the waves beat with the utmost violence.

OEHRINGEN, a city of the kingdom of Wirtemberg, in the circle of the Jaxt, the capital of a bailiwick of the same name, in the territories of the mediatized Prince of Hohenlohe-Oehringen. It stands on the river Ohra, is the residence of the prince, and contains, besides the palace, 480 houses, with 3327 inhabitants, who are occupied in making jewellery and gold and silver articles, also in the cotton manufacture, and in growing wine.

OELAND, or OLAND, an island in the Baltic Sea, a part of the province of Calmar, in Sweden. It is about seventy miles in length from north to south, and about seven miles in breadth from east to west. The western side is flat, and the eastern rather hilly; but the centre is a level consisting of tolerably good soil, which yields barley, rye, and oats, and, from the mildness of the climate, brings the harvest two weeks earlier than on the opposite continent. It has some good pastures, which furnish dairies; and a considerable fishery is carried on upon the coast. It contains no market-town, but has eight parishes, and 24,000 inhabitants.

OELS, a circle of the Prussian province of Silesia, which has become remarkable on account of its having been bestowed on the Duke of Brunswick when expelled from his hereditary dominions by Bonaparte. It was formerly a sovereignty, but is now mediatized; and the ancient race of its dukes has become extinct. It extends over 814 square miles, and contains nine cities and towns, 344 villages, and 164 hamlets, inhabited by about 95,000 persons. The chief place is the city of the same name situated on the river Oelse, which runs to the Weyda in its course to the Oder. It is surrounded with walls, and contains one Catholic and five Lutheran churches, 480 houses, and about 5000 inhabitants. In the ancient castle of the dukes is a numerous library and a cabinet of natural history. The chief employment of the inhabitants is in the linen trade.

ŒNOPTÆ, in Grecian antiquity, a kind of censors at Athens, who regulated entertainments, and took care that none drank too much or too little.

ŒREBRO, one of the provinces of the kingdom of Sweden, being the westernmost part of Westmanland. It extends in north latitude from 58. 40. to 60. 6. and in east longitude from 14. 6. to 15. 42., and contains a superficies of 3784 square miles. It is divided into four districts or bailiwicks, viz. Osterwick, Westrericke, Nora cum Linne, and Leke cum Carlscrona, and contains 110,000 inhabitants. It is surrounded with mountains, but none of them higher than 2000 feet, and the interior is flat or undulating. It is an internal province, but connected with Stockholm by means of the river Heilmaren. It contains a great number of fresh-water lakes. The climate is raw and cold, but in the short summer vegetation is surprisingly rapid. The best agriculture is in the southern part, but there the seed rarely produces more than four-fold. The chief grains are rye, oats, and barley; and of late potatoes and turnips have been introduced. The chief production is timber, and the cutting and preparing of it for market is the principal occupation. There are some mines of iron and of copper worked. The capital is the city of the same name, situated at the entrance of the river Svartelf into the Heilmaren. It is chiefly built of wood, has a good market, a church, and an hospital, and contains 750 dwellings, with 3240 inhabitants, a few of whom are employed in making cloths, hosiery, and ironmongery articles. Long. 15. 4. 5. E. Lat. 59. 15. 14. N.

ŒTA, in *Ancient Geography*, a mountain of Thessaly, extending from Thermopylæ westward to the Sinus Ambracicus, and in some measure cutting at right angles the mountainous country stretching between Parnassus to the south and Pindus to the north.

OETTINGEN, a city of the kingdom of Bavaria, in the circle of the Rezat, which, with a district around it of seventy square miles and 12,500 inhabitants, forms a bailiwick belonging to the mediatized Prince of Oettingen-Oettingen. The city is the residence of the prince. It stands on the river Wernitz, is well built, and contains a Catholic and a Lutheran church, 460 houses, with 3480 inhabitants, who are chiefly employed in making linen and cotton goods. Long. 10. 31. 5. E. Lat. 48. 57. 27. N.

OFFENBACH, a city of the grand duchy of Hesse, in Germany, in the province of Darmstadt, and the capital of a bailiwick of the same name. It stands on the river Maine, and is well built, being on one side surrounded with a wall, and on the other with a ditch. It contains 530 houses, with 6950 inhabitants, who are chiefly occupied in making iron and hardware, and a variety of ornamental articles of steel, silver, and gold.

OFFERINGS. Amongst the Hebrews there were several kinds of offerings, which they presented at the temple. Some were free-will offerings, and others were offerings of obligation. The first fruits, the tenths, and the sin-offerings, were of obligation; the peace-offerings, vows, offerings of wine, oil, bread, salt, and other things, which were made to the temple or to the ministers of the Lord, were offerings of devotion. The Hebrews called offerings in general *corban*. But the offerings of bread, salt, fruits, and liquors, as wine and oil, which were presented at the temple, they termed *mincha*. The sacrifices are not properly offerings, nor are they commonly included under that name.

OFFICIAL, in the canon law, an ecclesiastical judge, appointed by a bishop, chapter, or abbot, with charge of the spiritual jurisdiction of the diocese.

OFFICIAL is also a deputy appointed by an archdeacon as his assistant, and who sits as judge in the archdeacon's court.

OFFICINAL, in *Pharmacy*, an appellation given to such medicines, whether simple or compound, as are required to be constantly kept in the apothecaries' shops.

OFFING, or OFFIN, in nautical language, that part of the sea a good distance from shore, where there is deep water, and no need of a pilot to conduct the ship. Thus, if a ship from shore be seen sailing out to seaward, they say, "she stands for the offing;" and if a ship, having the shore near her, have another a good way without or beyond her, towards the sea, they say, "that ship is in the offing."

OGHAMS, a particular kind of stenography, or writing in cipher, which was practised by the Irish. Of these there were three kinds. The first was composed of certain lines and marks, which derived their power from their situation and position, as they stood in relation to one principal line, over or under which they were placed, or through which they were drawn. The principal line was horizontal, and served for a rule or guide, the upper part of which was called the left, and the under side the right; above, under, and through which line, the characters or marks were drawn, that stood in the place of vowels, consonants, diphthongs, and triphthongs.

OGIVE, in *Architecture*, an arch or branch of a Gothic vault, which, instead of being circular, passes diagonally from one angle to another, and forms a cross with the other arches. The middle, where the ogives cross each other, is called the *key*, being cut in the form of a rose, or a *cul de lampe*. The members or mouldings of the ogives are called *nerves*, *branches*, or *reins*; and the arches which separate the ogives, *double arches*.

OGYGES, king of the Thebans, or, according to others, of Ogygia and Actæ, afterwards called Bœotia and Attica. He is recorded to have been the first founder of Thebes and Eleusis. The famous deluge happened in his time, in which some say he perished, along with all his subjects, 1796 before our era.

OHANG JAVA, a cluster of islands in the Pacific Ocean, discovered by Tasman. Most of them are little better than large rocks. Lat. 4. 36. N.

OHETEROA, an island about twelve miles in circumference, in the South Pacific Ocean, without either harbour or anchorage, and only a foul and rocky bay on the west coast. The inhabitants are active, well made, and of a dark complexion. They form circles round their arms and legs, but have no figures on the other parts of their body. Their clothing is made of the bark of a tree, and is curiously coloured; and some of them wear bonnets, adorned with feathers, whilst others wear white stuff in the form of a turban. Their arms are lances made of very hard wood, and long pikes. This island was first discovered by Captain Cook in the year 1769. It is well inhabited, though it is not twenty miles in circumference. It has not, like the Society Islands, any coral reef surrounding it. Long. 150. 47. W. Lat. 22. 27. S.

OHEVAHOA, a steep and craggy island in the Southern Pacific Ocean, about fifteen leagues in circumference. Its deep valleys, and the sides of its hills, are clothed with trees and with verdure. It is situated in long. 139. 2. W. and lat. 9. 42. S.

OHIO, one of the principal states in the North American union, is situated between 38. 30. and 42. 0. of north la-

Ohio. titude, and between 80. 28. and 84. 42. longitude west from Greenwich. On the north it is bounded by Michigan and Lake Erie; on the east by Pennsylvania and the river Ohio; on the south by the Ohio River, which separates it from Virginia and Kentucky; and on the west by Indiana. Ohio may extend about 220 miles from north to south, and as much from east to west; but as Lake Erie projects considerably into the northern borders, and the Ohio cuts off much of its southern quarter, the area of the state cannot be computed at more than 200 miles square. Ohio occupies about one third of the plane which declines from Pennsylvania to the Mississippi, and may be considered generally as a surface of table-land, sloping in one direction towards the Ohio, and in the other towards Lake Erie. The state is divided by nature into four grand divisions, which are named after the principal waters on which they are situated. These are the Miami country, the Scioto country, the Muskingum country, and the Lake country. The interior and northern parts of Ohio are generally level, but the northern belt has large tracts of wet and marshy soil. They are however placed in such positions as render them easily drained; and when they are cleared of the forests which cover them, they will form not the least valuable parts of the state. In its primitive condition, Ohio was, with the exception of some central prairies, overspread with a dense forest, to which the great fertility of the soil gave a stupendous development; indeed the size, majesty, and variety of the trees of the Ohio basin has been a theme of just admiration. There are still extensive tracts of land heavily timbered, and which are as level as prairies. The forest-trees are the same as those of Kentucky and Indiana, excepting that the peccan tree, which is common on the waters of the Wabash, is seldom found here. The forests are deep, and some of them are in the richest soils, where, however, the trees are less remarkable for their size than for their straightness. On the head waters of the two Miamis, the Muskingum, and the Scioto, there are rich and extensive prairies, some of which are low and marshy, and others are elevated and dry, the latter being by no means so fertile as the former. Immediately on the borders of the Ohio, there are numerous tracts of intervale or meadow-land of exuberant fertility. In the interior parts, bordering on both sides of the Scioto, and on the two Miamis, are the most extensive tracts of rich and level land. About one quarter of the eastern and south-eastern divisions of Ohio is hilly, in some places too broken and precipitous to admit of cultivation; but in no parts are the hills very large or high, and nine tenths of the surface of the state are susceptible of cultivation. "On its whole wide surface," says Mr Flint, "there is scarcely any land so hilly, sterile, or marshy, as, with moderate labour, may not be subdued, drained, or cultivated. The whole region seems to have invited a hardy and numerous body of freeholders to select themselves moderate and nearly equal-sized farms, and to intersperse them over its surface. In respect to the smallness of the farms, the number, equality, and compactness of the population, not confined, as farther west, to the water-courses, but diffused over the whole state, it compares very accurately with New England."

Rivers. The principal river of Ohio is the noble and beautiful stream to which it owes its name; but this will demand a separate notice. The next largest and most interesting river in this state is the Great Miami, which rises between 40 and 41 degrees of north latitude, and interlocks with the Massissineway of the Wabash, and the St Mary's and Au Glaize, branches of the Maumee and Scioto. It has a south-westerly course of above fifty miles, flowing in a strong but generally smooth and unbroken current, through a valley of uncommon width and fertility, receiving several tributaries in its course. The Little Miami rises in the south-west corner of Madison county, and, after traversing several counties, joins the Ohio seven miles above Cincinnati. It is of little importance as a navigable stream; but it is valuable in a manufacturing point of view, there being upwards of sixty mills upon it. It has a number of branches; and about one hundred miles from its mouth it forms singular rapids, the stream being compressed to ten yards in width, and falling two hundred feet within no great distance. The country between the Great and Little Miami is in general finely watered, healthy, pleasant, and fertile, and may be characterised as the garden of the state. The Scioto is a considerable river of Ohio, and has the whole of its course in the state, being little short of two hundred miles, one hundred and thirty of which are navigable. It rises in a morass north of Logan county, in the southern division of the state, and has generally a south-easterly course. The banks of the Scioto now rank amongst the most fertile, eligible, and pleasant parts of the state. Between this river and the Muskingum is situated the great Hockhocking and its waters. It has a deep and still but narrow channel, and is navigable for boats forty miles above its mouth, having also a number of mills erected on it. The Muskingum rises near the sources of the Cuyahoga of Lake Erie, in the southern part of Connecticut Reserve. Its course is remarkably sinuous, but its general direction is to the southward. It has a long course, traversing a number of counties, is boatable in good stages of the water one hundred miles by the course of the river, and enters the Ohio at Marietta by a mouth two hundred and fifty yards wide. The Mahoning is also a large stream, which, with those already described, may be considered as belonging to the southern division of the state. In the north there is the Maumee, which rises in the north-eastern angle of the state of Indiana, and flows in a north-eastern direction, across the north-western borders of the state of Ohio, into the western extremity of Lake Erie. This important river has a course of one hundred miles, and is a broad, deep, navigable stream. It has a valuable fishery, and its banks in the season of vegetation are remarkable for the luxuriance of their verdure. The St Joseph, the St Mary's, and the Great and Little Au Glaize, are considerable tributary streams of the Maumee. The Sandusky rises in the western limits of Richland county, and runs in a general north-west direction ninety miles to the lake. It is more rapid than the other lake streams, but yet affords good navigation. Cuyahoga rises in the central parts of Geauga county, and falls into the lake at Cleveland, after a course of sixty miles, for the greater part of which distance it is boatable. Chagrin, Grand, Ashtabula, and Coneaught, are considerable streams, which rise near the lake, run in a northerly direction, and discharge their waters into it.

Ohio possesses an extensive and rich coal region in its eastern and north-eastern divisions, on the Muskingum, the Hockhocking, and the Scioto. The mineral is not only in great abundance, but of the best quality; and in the same region vast quantities of iron ore are found. Limestone, marble, and freestone abound; they are easily accessible, and are admirably adapted to building and public works. The useful earths and fossils are also in abundance. Specimens of gypsum are procured from Sandusky Bay. Salt springs are common, and some of them contain as much saline matter as the waters of the ocean. Nearly half a million bushels of salt are annually manufactured in the state. Those springs the waters of which are drank for medicinal purposes are most of them more or less impregnated with muriate of soda. The Yellow Springs, the most celebrated watering-place after Harrodsburgh Springs in the western country, are situated near the falls of the Miami, sixty-three miles from Cincinnati. The antiquities which belong to this state are somewhat similar to those described in the article New York; mounds of earth, in which have been found domestic utensils, pottery, vases, and trinkets.

Instruments of warfare have likewise been dug up, amongst which Mr Flint mentions a curious sword and an iron horse-shoe of a diminutive size.

Except along the deep vales of the Ohio, and those of the other streams near their influx into that great recipient, the climate is as uniform as the surface, and considerably more severe in the winter season than in corresponding latitudes on the Atlantic. But the other seasons are warmer, and the nature and luxuriance of the vegetation indicates a temperature of greater mildness in general. The summers are warm, and pretty regular, although to a certain extent subject to tornadoes. The central parts of the state are in the same latitude with Philadelphia. The mean temperature of the year at this city was found to be 53°; but during the same year that of Ohio was two degrees higher. As we recede from the Ohio, the temperature diminishes in a greater ratio than the latitude would indicate; but in general throughout the state there is a striking correspondence between the two. Whilst the summers are warm, the winters are very severe, and the river Ohio has occasionally been crossed at Cincinnati for nine consecutive weeks. At other times this season of the year is mild; but during the winter months the transitions from heat to cold and the reverse are frequent and violent. In that part of the state which slopes to the south, the snow seldom falls deep or lies long; but in Connecticut Reserve, and in the points which slope towards the lakes, they have deep and durable snows. Autumn is almost uniformly temperate, dry, and beautiful; and spring is also a pleasant season. The winds of Ohio, whether high or low, generally blow from the west and south-west at all times. In some parts, near marshes and stagnant waters, fevers and agues frequently prevail; but the climate in general is decidedly healthy.

Soil and productions.

The soil and the climate of Ohio together are admirably adapted to the most valuable vegetable productions which grow in such a latitude. The soil is very productive, without, however, being so remarkable in this respect as some parts of Illinois and Missouri. After the severity of winter abates, which is early in February, vegetation begins to put forth its powers; and as the heat of spring and summer takes effect upon the soil, it advances with astonishing rapidity. Ohio, generally, has a soil admirably adapted to wheat. Indian corn is the staple grain, and it is nowhere raised more easily, or in greater abundance. On rich alluvial soils 110 bushels have been produced from an acre; but fifty may be considered as about the average crop. Rye, barley, oats, spelts, buckwheat, and all other grains, are raised in great abundance and perfection. Melons, squashes, pumpkins, the pulses, garden vegetables both bulbous and others, as potatoes, onions, beets, carrots, parsnips, asparagus of the best description, and various culinary products of the soil, attain the highest development. From its stiff, clayey nature, the soil retains moisture well, and is better fitted for gardens than the soils farther west. Fruits of all kinds are raised in the greatest profusion; and apples in particular are very plentiful. Pears, plums, peaches, cherries, strawberries, grapes, and what not, are cultivated to such an extent as amply to supply the markets. "In a few years," says Mr Flint, "this state will take place of any in the Union, in the abundance and excellence of its fruits of all kinds. From the fulness and richness of the clusters of cultivated grapes, it is clear that this ought to be a country of vineyards. The Germans have already made a few establishments of the kind with entire success. Apricots, nectarines, and quinces succeed; and this state is the appropriate empire of Pomona. Recently, tobacco has been added to the articles cultivated. ...Hemp is an article of cultivation in some parts of the state. Agricultural improvement, however, proceeds with slow pace. The people generally are not at all given to experiment, and continue to farm in the old and beaten routine....Besides trees, shrubs, and vines, this state produces a great abundance of indigenous productions that are useful in medicine. We may mention *actea racemosa*, squaw root, Virginia snake root, Indian turnip, ginseng, which is dug in considerable quantities as an article of commerce, colombo, labelia, valerian, blood root or sanguinaria, canadensis, and various other herbaceous medicinal plants."

Commerce.

This state, being more populous than any other in the west, and possessing in many respects manufacturing capabilities, has taken precedence of all the rest in manufactures. Cotton yarn, cloth, and woollen goods, are already manufactured to a considerable extent, as are also flour and spirits; and family manufactures are likewise industriously prosecuted. The principal domestic articles of trade are horses, cattle, swine, whisky, flour, and tobacco. Those articles which are exported from the northern and some interior counties are frequently sent to Montreal and New York markets, by way of Lake Erie. From the southern parts of the state they are transported down the Ohio and Mississippi to New Orleans. Foreign goods are received from the same place by the steam-boats, and from Philadelphia and Baltimore across the Alleghany Mountains. "The surplus produce of the state of Ohio," says Mr Pitkin, in his Statistical View of the Commerce of the United States, "it is believed, may be calculated at about ten millions. The exports of Cincinnati alone, in 1833, were valued at five millions of dollars. This amount does not probably exceed the truth, when it is considered that the number of hogs slaughtered in that city in 1833 was 123,859, which would make as many, and probably more, barrels of pork, and, in the same year, 21,880 barrels of pork came to that city by the Miami Canal, making about 150,000 barrels in the whole, and which, at nine dollars per barrel, would be 1,359,000 dollars; and that in 1834, the number slaughtered was 150,000. And we cannot but here remark, that the whole quantity of pork exported from the United States in 1833 was only 105,870 barrels, leaving in favour of Cincinnati 45,000 barrels." It is of course taken for granted, that of the 150,000 barrels of pork said to be made at this city, all above the 45,000 entered as having been exported was reserved for home consumption. Mr Pitkin continues, "the exports of Cleveland on Lake Erie, in the same year, was 1,794,000 dollars coastwise, and 250,000 to foreign places, and from Huron 274,840 dollars; and from the country of Muskingum, on the river of that name, and from the flourishing village of Zanesville, with her numerous flourishing mills, as ascertained by those well acquainted with the facts, was 500,000 dollars. The value of the exports from these places alone make about seven millions and three quarters; and when it is considered that the quantity of tobacco raised in Ohio in 1833 was 10,000 hogsheads, only 3000 of which is included in the above exports from Muskingum, and when to these are added the exports from the Sciota valley, and from many other places on the Ohio River, and on the lake, we apprehend that the surplus produce of Ohio cannot be less than ten millions of dollars."

Statistics.

The following account of the statistics of Ohio for 1836 is taken from the American Almanac for 1837.

Value of Taxable Property.

	Dollars.
Lands (17,819,631 acres), including buildings	58,166,821
Town lots, including houses, mills, &c	15,762,594
Horses (262,291, valued at forty dollars each)	10,491,640
Cattle (455,487, valued at eight dollars each)	4,043,896
Merchants' capital and money at interest	7,262,927
Pleasure-carriages, 2603, valued at	199,518
Total	95,927,396

Ohio.

Taxes Levied.

	Dollars.
State and canal tax	142,854·15
County and school tax	396,505·80
Road tax	66,482·16
Township tax	102,991·65
Corporation, jail, and bridge tax	51,276·89
Physicians' and lawyers' tax	3,144·19
School-house tax	1,482·84
Delinquencies of former years	13,044·37
Total	777,782·05

Foreign debt, 4,400,000 dollars;—legal interest	260,000
Domestic do.....579,287 dollars;—ditto	34,757
Total...4,979,287	294,757
Canal tolls for 1835, and receipts from the sale of Ohio canal lands	306,906
Amount of school funds on loan to the state, 15th November 1835	803,432

Although the first permanent settlement was made in Ohio not more than fifty years ago, and although it was admitted into the Union as a state as recently as 1802, yet it has now become one of the most considerable states in the union, has entered largely into the system of internal improvement, and has constructed one of the longest canals in the world. The state canals are under the direction of a board of canal commissioners; and the Ohio and Miami Canals, which, together with their branches, are more than four hundred miles in extent, have been constructed at the expense of the state. For an account of the canals of Ohio, see the article NAVIGATION, INLAND.

Railroads. Railroads have likewise been constructed on the same extensive scale, and numbers of them are in course of being laid. Mad River and Lake Erie Railroad, extending from Dayton to the city of Sandusky, is to be 153 miles in length. The Pennsylvania and Ohio Railroad is designed to commence at Pittsburgh, and terminate at Massillon on the Ohio Canal, the length being 180 miles. There are some others of smaller size; and some idea may be formed of the extent to which these works are carried, from the fact that no less than twenty-eight companies were incorporated in the year 1836. In connection with trade and internal improvement may be mentioned the banks of Ohio. In the year 1835 there were thirty-one banks in this state; and the condition of twenty-nine of these, from which returns were received, was, that they had of specie 1,906,715, and of capital 6,390,741; and that their circulation was 5,654,048. The legal interest in Ohio is six per cent.; but there is no law against usury, so that in some parts it is seldom less, and often more, than ten per cent.

Education and literature. A laudable zeal has been shown to diffuse education throughout this state. In the year 1825 the New England system of tuition was introduced into Ohio, and by various emendatory enactments it has now acquired a degree of form and consistency. By an act of the state the trustees of every incorporated township are required to divide it into a suitable number of school districts, the prudential concerns of which are managed by three school directors, a clerk, and a treasurer. The funds for maintaining this vast system arise from various sources besides the easy tax of one mill upon a dollar, constituting a large and growing revenue. By this act it is provided that the youth of every class, without distinction, shall be instructed in reading, writing, and arithmetic, as well as in other necessary branches of education. There are no less than nine colleges or universities, viz. the university of Ohio, at Athens, with five instructors, seventy-two alumni, twenty-six ministers, forty-five students, and about a thousand volumes in the college library, and as many in that of the students; the Miami university, at Oxford, with eight instructors, eighty alumni, seventeen ministers, one hundred and twenty-six students, and 1200 and 2500 volumes respectively in the college and students' libraries; the Franklin university, at New Athens; the Western Reserve university, at Hudson; the Kenyon university, at Gambier; the Granville university, at Granville; the Marietta university, at Marietta; the Oberlin institution, at New Illyria; and the Willoughby university, at Chagrin; all of which are smaller than the first two, but have from fifty to one hundred students. There are five theological seminaries, a presbyterian college at Cincinnati, and another at Hudson, a Protestant episcopal college at Gambier, a Lutheran theological school at Columbus, and a Baptist institution of the same kind at Granville. There are two medical schools; one at Cincinnati, having six professors, and another at Northing, with four professors. There is a law college at Cincinnati, which has three professors. Amongst institutions of a public character may be mentioned an asylum for the deaf and dumb, which has been established at Columbus. Literature is making considerable progress in Ohio. In 1810 there were only fourteen newspapers in the state, and in 1834 their number amounted to 140. There are, besides, several other periodicals of a literary and scientific nature.

Religion. Almost every religious denomination is found in this state, but the Presbyterians and Methodists predominate. In 1831, which is the latest complete return that we have obtained, the numbers were, of Presbyterians, 22,150 communicants, having 346 churches; of Baptists, 8801 communicants, having 240 churches; of Methodists, 36,064 members; of Lutherans, 8706 communicants; of Associate Presbyterians, sixty-five congregations; of German Reformed, eighty-two congregations. The Episcopalians had also sixteen ministers, and the New Jerusalem church four societies; and there were, besides, a number of Friends and Roman Catholics, and some Universalists, Unitarians, and Shakers. "It is affirmed by a gentleman," says Mr Flint, "well known for his researches into the antiquities of this state, that there is a greater number of professors of religion, in proportion to the whole number of the people, than in any state in the Union. There are a vast number of religious societies; but there is not a great number that have regularly established pastors. The custom of itinerating preaching, as a supply, is very prevalent. The people are generally a quiet, orderly, peaceable, moral, and industrious race. Suicide, excesses, murders in affray, and instances of deliberate and atrocious cruelty, are rare; and the general moral character of the people is highly respectable."

From the census of 1830 we learn that there were at that time in Ohio the remains of Indian tribes, amounting to 2350 persons. They then owned 390,846 acres of land, besides 16,200 acres which were secured to individuals belonging to the several tribes. These lands are secured by treaty to the Wyandotes, Shawnees, Senecas, Delawares, and Ottawas; the other remnants of tribes being classed with these. Some of them have sold their shares; but to those which still hold them, considerable annuities are paid by the national government. The number of individuals belonging to these tribes is gradually diminishing, and they must soon entirely disappear in the tide of white population which is fast overspreading their native territories. There are not many negroes in Ohio, and none are held as slaves. Few descriptions of the inhabitants are exempted from military duty. The militia of this state is principally composed of hardy agriculturists, and exceeds one hundred and fifty thousand men. A portion of the land in Ohio still belongs to the United States. In the north-east part of the state there is a tract containing 3,300,000 acres, called New Connecticut, or Connec-

Ohio. ticut Western Reserve. The fee of these lands is in the state of Connecticut, but Ohi has the jurisdiction. The state of Virginia also owns a tract of above four millions of acres, called the Virginia military lands, which are situated between the Scioto and Little Miami Rivers. The following table exhibits the

Population of the Counties and County Towns of the State of Ohio in 1830.

Counties.	Population in 1830.	Square Miles.	County Towns.	Population.	Distance from Cincinnati.	Distance from Washington.
Adams	12,278	550	West Union	429	101	460
Allen	578	542	Wapaghkonetta	...	110	507
Ashtabula	14,584	705	Jefferson	270	191	325
Athens	9,763	744	Athens	729	73	344
Belmont	28,412	536	St Clairsville	789	124	275
Brown	17,867	492	Georgetown	325	104	480
Butler	27,044	486	Hamilton	1,097	101	488
Champaign	12,130	417	Urbana	1,102	50	447
Clark	13,074	412	Springfield	1,080	43	437
Clermont	20,466	515	Batavia	426	109	476
Clinton	12,292	400	Wilmington	607	67	444
Columbiana	35,508	865	New Lisbon	1,138	152	282
Coschocton	11,162	562	Coschocton	333	84	336
Crawford	4,778	584	Bucyrus	298	69	409
Cuyahoga	10,360	475	Cleveland	1,076	138	354
Dark	6,203	660	Greenville	160	103	501
Delaware	11,523	610	Delaware	532	23	419
Fairfield	24,788	540	Lancaster	1,530	28	372
Fayette	8,180	415	Washington	300	45	422
Franklin	14,766	520	Columbus	2,437	...	396
Gallia	9,733	495	Gallipolis	755	108	362
Geauga	15,813	600	Chardon (township)	881	157	332
Green	15,084	416	Xenia	919	57	453
Guernsey	18,036	621	Cambridge	518	83	314
Hardin	...	500	Hardy	...	66	436
Hamilton	52,321	400	Cincinnati	24,831	112	497
Hancock	813	575	Findlay	52	114	502
Harrison	20,920	450	Cadiz	820	124	278
Henry	260	474	Damascus	...	161	485
Highland	16,347	555	Hillsborough	564	74	441
Hocking	4,008	432	Logan	97	47	370
Holmes	9,133	400	Millersburg	319	80	341
Huron	13,345	840	Norwalk	310	113	399
Jackson	5,974	492	Jackson	329	74	387
Jefferson	22,489	400	Steubenville	2,937	149	260
Knox	17,124	610	Mount Vernon	1,021	45	375
Lawrence	5,366	426	Burlington	149	135	405
Licking	20,864	666	Newark	999	34	362
Lorain	5,696	555	Illyria	668	130	377
Logan	6,442	425	Belle Fontaine	266	62	458
Madison	6,190	448	London	249	27	423
Marion	6,558	527	Marion	287	47	416
Medina	7,560	473	Medina (township)	622	111	357
Meigs	6,159	405	Chester	164	94	343
Mercer	1,110	570	St Mary's	92	111	508
Miami	12,806	444	Troy	504	78	474
Monroe	8,770	563	Woodsfield	157	140	294
Montgomery	24,252	450	Dayton	2,965	66	462
Morgan	11,796	500	M'Connesville	267	70	340
Muskingum	29,325	664	Zanesville	3,094	59	336
Paulding	160	432	...	...	...	...
Perry	14,018	402	Somerset	576	46	354
Pickaway	15,935	495	Circleville	1,136	26	394
Pike	6,024	414	Piketon	271	65	409
Portage	18,827	752	Ravenna (township)	806	127	320
Preble	16,255	432	Eaton	511	92	488
Putnam	230	576	Sugar Grove	...	148	538
Richland	24,007	900	Mansfield	840	71	380
Carry forward	764,727	31,032				

Ohio.

Counties.	Population in 1830.	Square Miles.	County Towns.	Population.	Distance from Cincinnati.	Distance from Washington.
Brought forward	764,727	31,032				
Ross	24,053	672	Chillicothe	2,846	45	404
Sandusky	2,851	656	Lower Sandusky	351	103	428
Scioto	8,730	581	Portsmouth	1,064	91	421
Seneca	5,148	546	Tiffin	248	85	431
Shelby	3,671	418	Sydney	240	86	482
Stark	26,784	780	Canton	1,257	116	319
Trumbull	26,154	875	Warren	510	157	297
Tuscarawas	14,298	654	New Philadelphia	410	107	314
Union	3,192	430	Marysville	142	37	433
Van Wert	49	432	Willshire	...	146	533
Warren	21,493	400	Lebanon	1,157	83	468
Washington	11,731	670	Marietta	1,207	106	304
Wayne	23,344	660	Wooster	977	86	347
Williams	377	600	Defiance	52	175	511
Wood	1,095	744	Perrysburgh	182	135	460
Total	937,679	40,150				

The increase of population in the state of Ohio has been rapid almost beyond example. In the year 1790 it was only about 3000; in 1800, 45,365; in 1810, 230,760; in 1820, 581,434; and in 1830, 937,679.

For an account of Cincinnati, the principal city of Ohio, see the article Cincinnati. Columbus, the political metropolis, is situated near the centre of the state, upon the east bank of the Scioto River. The beautiful slope on which it stands, just below the confluence of the Whetstone River with the Scioto, was a compact forest in 1812. It is now cleared and well cultivated, and the city contains some excellent public buildings, including a penitentiary, an asylum for the deaf and dumb, and above three thousand inhabitants. Steubenville, the seat of justice for Jefferson county, is situated on the western bank of the Ohio, near the Pennsylvania boundary. It was laid out with great regularity in 1798, and is situated in the centre of a rich and populous country. It has the usual number of public buildings found in towns of the same size, and it possesses cotton, woollen, and other manufactures. Chillicothe is finely situated upon a level alluvial plain on the west bank of the Scioto, forty-five miles in a right line from its entrance into the Ohio. It was laid out with great regularity in 1796, and contains some handsome buildings. It possesses several cotton factories, and a number of flour and other mills. Marietta, the oldest town in the state, is situated on the Ohio, a little above the mouth of the Muskingum River. Ships were formerly built here, but this business has been discontinued, and the town, although very advantageously placed, has not prospered like many others in the state less favourably situated. Sixty miles north of Marietta, on the Muskingum, is the town of Zanesville, principally distinguished for its manufactures of iron. Here there are likewise a number of flour and other mills, driven by the waters of the Muskingum; and two or three glass-houses. Cleveland, situated upon the southern shore of Lake Erie, at the mouth of Cuyahoga River, is destined, from its position, to become an important town. It is one of the principal points for embarkation on the lake, and during the last American war was a provision dépôt, and a place where many boats and other lake craft were built. Cleveland is intermediate between Buffalo and Cincinnati, and is the dépôt of that vast quantity of merchandise which is destined for the east and west. One of the most important places on Lake Erie is Sandusky, situated on the southern shore of a bay of the same name. Although it is comparatively a young settlement, it has a great number of stores, and is one of the chief points of landing and embarkation between the Mississippi Valley and New York, Buffalo, and Detroit. The other ports or harbours on Lake Erie are Put-in Bay, Maumee Bay, Fair Port, and Ashtabula Creek. The relative importance of these, as well as the other towns belonging to Ohio, will be seen from our tabular view of the counties and county towns.

The first permanent settlement in the state of Ohio was made at Marietta, on the 7th of April 1788, by forty-seven persons from Massachusetts, Rhode Island, and Connecticut. In the year following a settlement was made at Columbia, six miles above Cincinnati, by a company principally from Pennsylvania. In September 1799, the first territorial legislature assembled at Cincinnati, under the ordinance of congress of the 13th July 1786, for the government of the territory of the United States north-west of the river Ohio. On the 30th of April 1802, congress passed an act authorizing the calling of a convention to form a state constitution for that part of the North-west Territory which now constitutes the state of Ohio. On the 1st of November following the convention met at Chillicothe, and formed the present constitution, by which Ohio was admitted into the union. The following is an outline of the constitution of Ohio. The legislative power is vested in a senate and house of representatives, which together are styled the General Assembly of the State of Ohio. The representatives are elected annually on the second Tuesday in October; and they are apportioned amongst the counties according to the number of white male inhabitants above twenty-one years of age. Their numbers cannot be less than thirty-six, nor more than seventy-two. The senators are chosen biennially, and are apportioned according to the number of white male inhabitants of twenty-one years of age. Their number cannot be less than one third, nor more than one half of the number of representatives. The executive power is vested in a governor, who is elected by the people for two years, on the second Tuesday in October; and his term of service commences on the first Monday in December. The general assembly meets annually at Columbus, on the first Monday in December. The right of suffrage is granted to all white male inhabitants above the age of twenty-one years, who have resided in the state one year next preceding the election, and who have paid or are charged with a state or county tax. The judicial power is vested in a supreme court, in courts of common pleas for each county, and such other courts as the legislature may from time to time establish.

The judges are elected by a joint ballot of both houses of the general assembly, for the term of seven years. (R. R. R.)

OHIO, a great river of the valley of the Mississippi, in North America, formed by the confluence of the Alleghany and Monongahela Rivers at Pittsburgh, in the western part of Pennsylvania. The highest sources of the Alleghany are in Potter county, Pennsylvania, twelve miles to the eastward of Condersport, where they interlock with the head waters of the Genessee River, and the eastern and western branches of the Susquehannah. During its course through Pennsylvania, which is exceedingly irregular, it is joined by several streams, the most considerable of which are, Toby's Creek, extending one hundred miles into the interior of Pennsylvania, and the Kiskiminitas, formed by the junction of the Conemaugh and Loyalhanna, which rise near the Alleghany Mountains, one hundred miles distant. This branch of the Ohio, although its volume is not apparently wider than the other, is by far the most important tributary. It has a swift, sweeping, and rapid current, and often a rocky bottom, whence huge blocks rise to the surface of the water. In the spring time, when it is full, flat and keel boats descend it rapidly, without any danger. It has been navigated by steam-boats, but has been found one of the most difficult currents to stem ever attempted by these vessels. Monongahela River, the other fork of the Ohio, rises in Virginia, about seventy miles north-west of Morgantown. It traverses a rich and well-settled country, celebrated for its whisky, flour, and iron manufactures. The banks are often bold and high bluffs, and in some places the country is hilly. In good stages of the water, it is boatable by large boats for about one hundred miles from its mouth. During its course it receives the waters of a number of tributary streams, the most important of which is the Youghiogeny River, or, as it is commonly called, the Yough, which rises near the upper waters of the Potomac, the rivers being only separated by a spur of the mountains. From the western declivity of these mountains, both this and the main river receive a great accession of mountain streams. The united current, which has now become broad and majestic, flows in a north-west course to Pittsburgh, and where it unites with the Alleghany it is more than four hundred yards in breadth. At the confluence of the two great branches, the Ohio is somewhat more than six hundred yards wide, and it immediately assumes that broad, placid, and beautiful aspect which it maintains to its junction with the Mississippi, in latitude 37. 0. north, and longitude 88. 52. west. Its length from Pittsburgh to its mouth is about nine hundred miles, including the windings of the river; but the direct distance is only six hundred and fourteen miles. Its breadth varies exceedingly, being in some parts fourteen hundred yards, whilst in others it is only four hundred yards across. At Cincinnati it is about eight hundred yards wide, and this is nearly its average breadth. For thirty miles below Pittsburgh its course is north-west. It then turns slowly to the west-south-west, and pursues that general direction for some five hundred miles. It flows south-west for above one hundred and fifty miles, then westward above two hundred and fifty miles, and finally south-west about one hundred and seventy miles through that low and swampy country in which it joins the "Father of waters." Between Pittsburgh and its mouth it is diversified with about one hundred considerable islands, besides a great number of tow-heads and sand-bars, which in low stages of the water greatly impede navigation. Some of these islands are of exquisite beauty, and afford most lovely situations for retired farms. The passages between them and the sand-bars at their head are amongst the difficulties of the navigation of the river. Notwithstanding these obstacles, however, it is well adapted for boat navigation, the current being remarkably smooth and gentle, excepting at Louisville in Kentucky, where it is broken by falls, the water running for several miles with great rapidity, although not so much so as to be insurmountable by boats. A canal round these falls, a work of great magnitude and utility, has been completed. The annual range of the Ohio, from low to high water, is about fifty feet; the extreme range is ten feet more. When lowest it may be forded at several places above Louisville. It is generally lowest in August, September, and October, and highest in December, March, May, and June. Throughout the year it is subject to sudden and very considerable elevations and depressions. Near Pittsburgh it is frequently frozen over for several weeks during the winter, and this has sometimes been the case four hundred miles lower down. Generally, the navigation upward is suspended by floating ice for eight or ten weeks in winter. When the river is at its mean height, its current is about three miles an hour; when higher and rising it is more, and when very low it does not exceed two miles an hour. Above two hundred steam-boats ply on the Ohio, a great part of which are employed in the commerce of the states bordering on the river; but they also connect with it the commerce of the states on the Mississippi. The produce of the contiguous states is readily transported to this channel by the numerous navigable rivers which it receives, and is thence conveyed to New Orleans, the grand commercial emporium of the valley of the Mississippi. The Ohio and all its tributaries cannot, it is believed, have less than five thousand miles of boatable waters; and, taking all circumstances into account, few rivers in the world can vie with it, either in utility or beauty. From its very commencement it affords most delightful prospects. Rivers of a romantic and beautiful character flow into it almost at equal distances, like lateral canals. Its valleys are of extraordinary depth and fertility; generally high and dry, and for the most part healthy; whilst the configuration of the country on the banks has much grandeur, softness, and variety. Of the rivers and creeks which join the Ohio, the number is very great. The following are all navigable, in moderate or high stages of the water, by steam-boats, for considerable distances, viz. the Muskingum, Great Kenhawa, Big Sandy, Scioto, Great Miami, Kentucky, Green, Wabash, Cumberland, and Tennessee. The last is by far the largest and most important tributary of the Ohio, watering considerable portions of Alabama, Tennessee, and Kentucky. Of creeks and smaller rivers there are probably nearly two hundred which enter the Ohio; but a list of them would only be a dry catalogue of uncouth names. (R. R. R.)

OHITTAHOO, one of the Marquis of Mendoza's Islands, in the Southern Pacific Ocean. It is about nine miles in length and twenty-one in circumference, and is intersected by a narrow ridge of hills, which are divided by deep, narrow, and fertile valleys, well watered, and adorned with trees. This, with other three islands which lie near it, was discovered in July 1595, by Alvaro Mendana, who gave them their name, in honour of the viceroy of Peru. A cove in which the European vessels usually anchored is situated in long. 139. 8. W. and lat. 9. 55. S.

OHRDRUFF, a city of the duchy of Saxe-Gotha-Altenburg, in Germany, the capital of a bailiwick of the same name, which, besides the city, contains six villages, 1700 houses, and 7000 inhabitants. It belongs to Prince Hohenlohe-Neuenstein. The city stands near the borders of the Thuringian Mountains, on the small river Ohre. It is surrounded with walls, and has a palace for the prince, four churches, a lyceum, an hospital, 840 dwellings, and 3480 inhabitants, who are industrious in making wood ware, in tanning leather, and in producing paper, copper utensils, and several smaller articles.

OIA, a river of Asiatic Russia, which falls into the Gulf of Obskaia. Long. 72. 24. E. Lat. 68. N.

OIL, an unctuous and inflammable substance, obtained from several natural bodies, as animal and vegetable substances.

OISE, a department of the north of France, formed out of the ancient Isle of France, and the districts of Beauvaisis and Valois. It extends in north latitude from 49. 7. to 49. 38. and in east longitude from 1. 28. to 3. 4. It is bounded on the north by the Somme, on the east by the Aisne, on the south by the Seine and Marne and the Seine and Oise, and on the west by the Eure; and it is divided into four arrondissements, which are subdivided into thirty-five cantons and 738 communes. It extends over 2428 square miles, and, according to the census of 1836, contains 398,641 inhabitants, and elects three deputies to the national representative body. The face of the country is plain or undulating, with a chain of calcareous hills of moderate height, of which Mount Cæsar on the eastern part is the highest. The soil is various, being in some parts clayey and in others sandy with marl, and generally a calcareous subsoil, except in the marshy portions near the streams. The Oise runs through it till it falls into the Seine, and it is navigable for barges. The Aisne, another navigable river, passes through a part of this department before it joins the Oise. There are a great number of smaller streams, some with and some without a name, all of which reach the sea ultimately through the Seine. The climate is dry and healthy, except in the marshy parts and near the woods, which cover about one seventh part of the whole surface. The agriculture is tolerably conducted; but the paucity of manure causes a great part of the land to be left fallow; yet it yields more corn than is required for the consumption, and in average years can spare one fourth of its growth for the supply of the surrounding departments. Besides corn, it yields a vast quantity of fruit, especially cherries, which can be conveyed by the rivers to Paris and other large cities. A great quantity of apples is converted into cider. The vines in general produce only a weak wine, not capable of being long preserved, except some of Ancerville and of Villars-Saint-Sepulcre, which are preferred to all the others of Picardy. The breeding of horses is carefully attended to, and some excellent ones are reared. The stock of oxen and sheep is low for the extent of country; but the races of the latter have been recently improved by the crossings with Merinos, and some fine wool is now furnished to the manufacturers. There are fabrics of linen, woollen, and cotton goods in several places; a considerable quantity of thread lace is made by the females; and there are also many tanneries and potteries. There is a considerable transit trade on the rivers, and they, as well as the rivulets, afford much fish.

OKEHAM, or OKHAM, a market-town, the capital of the county of Rutland, and situated in a rich valley called the vale of Cadmus. It is ninety-five miles from London, and has a good market on Saturday. It has an ancient castle, now converted into an assize-hall and a county jail. The parish church, dedicated to All-Saints, is a fine old structure, with a lofty spire, which is visible a great way around it. It has no corporation; but whatever power of a municipal nature is exercised is derived from the Earl of Winchelsea or the Dean of Westminster, who are lords of the two manors into which the town is divided. Near to it is Burleigh-on-the-Hill, a noble mansion of the Earl of Winchelsea. The population amounted in 1801 to 1613, in 1811 to 1719, in 1821 to 2160, and in 1831 to 2440.

OKHOTZK, one of the four circles of Asiatic Russia, in the government of Irkoutsk. It extends along the gulfs of the Eastern Ocean, called the Seas of Okhotzk, of Kamtschatka, and of Anadir. The climate is damp and unhealthy, being exposed to thick mists, from so great an extent of ocean; and the country is not only barren, but unwholesome. This damp and poisonous atmosphere continues for ten miles inland, when the sea air is arrested by a ridge of moderately-elevated hills. Beyond this boundary the country is more fertile, as trees are found to grow well, and rich meadows are seen.

The town of Okhotzk is built upon a long and narrow ridge, enclosed between the sea and the river Okhota, and formed chiefly from an accumulation of marine débris. This town consists of 130 houses, extending in a line of about two thirds of a mile, though it is not more than from 100 to 300 feet broad. It has a church, some magazines, and a double row of shops. Okhotzk is the channel of trade between Irkoutsk and Kamtschatka. The goods are conveyed chiefly by water, there being a very short interval of land carriage. But it is a tedious and difficult voyage, and even dangerous from the barbarous nature of the people who inhabit the banks of the rivers. The land journey is likewise dangerous. So difficult is the country, that the goods can be carried only on pack-horses, or on men's backs, as there are no waggons of any description; and, on account of the danger of sinking in morasses, it can be performed only in the spring. The inhabitants of the town consist chiefly of mariners and Cossacks. Besides the officers of the court of justice, there are two priests. Long. of the town 142. 44. E. Lat. 59. 20. N. The Sea of Okhotzk is a large gulf of the Eastern Ocean, enclosed between Kamtschatka, the circle of Okhotzk, part of Chinese Tartary, and Saghalien. At its mouth are the Kurile Islands and part of Jesso.

OKIRAH, a town of Bengal, in the district of Burdwan, 105 miles north-west from Calcutta. Long. 87. 15. E. Lat. 23. 38. N.

OLANGO, a small island amongst the Philippines, near the eastern coast of Siba. Long. 123. 51. E. Lat. 10. 33. N.

OLCHANSKAIA, a fortress of Asiatic Russia, in the government of Orenburg, and situated on the small river Olchanka. It contains a church and several streets, and forms part of the military line of Samara. The inhabitants consist chiefly of veteran soldiers. It is 177 miles south-east of Orenburg.

OLDCASTLE, SIR JOHN, commonly called the Good Lord Cobham, was born in the reign of Edward III. He obtained his peerage by marrying the heiress of that Lord Cobham who had strenuously opposed the tyranny of Richard II.; and, with the estate and title of his father-in-law, he seems to have acquired the patriotic and independent spirit for which that nobleman was distinguished. By his means, the statute against provisors was revived, and guarded with more severe penalties than ever; and he was also one of the leaders of the party who, having drawn up a number of articles against the corruptions which then prevailed amongst ecclesiastics, presented them in the form of a remonstrance to the Commons. He was at great pains in collecting and transcribing the works of Wickliffe, which he dispersed amongst the people; and he sent a number of his disciples as itinerant preachers into various parts of the country. In the reign of Henry IV. he commanded an English army in France, at that time distracted by the contentions of the two factions of Orleans and Burgundy; and, in this capacity, he compelled the Duke of Orleans to raise the siege of Paris. In the reign of Henry V. he was accused of heresy, the growth and extension of which was mainly attributed to his influence. The king having a favour for Lord Cobham, who held a domestic office at court, delayed the prosecution, and kindly undertook, by reasoning and expostulation, to reclaim him from his errors. But the attempt proved abortive. "Next to God," said his lordship, "I profess obedience to my king; but as to the spiritual dominion of the pope, I could never see upon what foundation it is claimed, nor can I pay him any obedience;" and he added, "It is as sure as God's word is true, he is the great Antichrist foretold in holy writ." This answer, so different from what had been expected, deeply offended the king, who, turning away in visible displeasure, withdrew his favour from Cobham, and left him to the censures of the church, which speedily overtook him. Being summoned to appear before the archbishop, he disobeyed the citation, and was excommunicated on the ground of contumacy. Reckless in exposing himself to danger, he seems to have wanted the courage to confront it boldly when it appeared in a definite shape. Hoping to avoid the impending storm, he waited upon the king with a confession of his faith in writing; but whilst he was in the royal presence, an officer of the ecclesiastical court entered, and cited him to appear before the archbishop, upon which he was immediately conveyed a prisoner to the Tower. When brought before the proper tribunal, he read his opinion of the several articles in regard to which he supposed that he had been called in question, particularly the eucharist, images, penance, and pilgrimages; but he was informed, that in some things he had not been sufficiently explicit in stating his particular views; that on all these points the church had already decided, and by her determinations all Christians ought to abide; that these determinations would be given him as a direction of his faith; and that, in a few days, he must appear again and state his opinions. The second examination, however, ended like the first. Cobham declared that "he knew none holier than Christ and his apostles; and that these determinations were surely none of theirs, as they were against Scripture." He was accordingly condemned as a heretic, and remanded to the Tower; but he contrived to effect his escape from prison, and lay concealed in Wales, until information reached the king at Eltham that about twenty thousand Lollards had assembled for his destruction at St Giles, with Lord Cobham at their head. A bill of attainder then passed against him, a price was set upon his head, and a perpetual exemption from taxes promised to any town which should secure him. After having spent four years in Wales, he was at length seized, carried to London, and executed in St Giles's Fields, in December 1417, with circumstances of cruelty characteristic of the times.

As a writer, Lord Cobham is only known by a piece entitled "Twelve Conclusions, addressed to the Parliament of England," at the end of the first book of which are some monkish rhymes in Latin, which Bale has preserved. "A Brefe Chronycle concerning the Examynacyon and Death of the blessed martyr of Christ, Syr Johan Oldecastell, the Lorde Cobham," was also published by Bale, and reprinted under the care of a Mr Lewis of Margate in 1729. Since that time the life of Lord Cobham has been written by Mr Gilpin, who describes him as a person of uncommon parts and varied talents, well qualified either for the cabinet or the field; as possessing acquirements equal to his parts; and, besides, as remarkable for his ready and poignant wit in conversation. "It was his thirst of knowledge," adds his biographer, "which first brought him acquainted with the opinions of Wickliffe. The novelty of them engaged his curiosity. He examined them as a philosopher, and in the course of his examination became a Christian." (A.)

OLDENBURG, a sovereign duchy in the north-east of Germany, but consisting also of two other portions separated from it, though both of them are of small extent. One of these smaller divisions in the north is called the principality of Lubeck, consisting of a small territory surrounded by the Danish territory of Holstein, and some small spots on the banks of the Trave, and near Schwartau, adjoining to the territory of the republic of Lubeck. The other of these small divisions is on the western side of the Rhine; it is called the principality of Birkenfeld, and is wholly surrounded by the Prussian province of the Lower Rhine. The whole of these three divisions extend over 2721 square miles, and comprehend nine cities, ten market-towns, and 776 villages and hamlets, with 233,400 inhabitants, of whom 161,420 adhere to the Lutheran church, 68,000 are Catholics, and the remainder, excepting 900 Jews, are Calvinists. The population of the principality of Lubeck is 19,070, that of Birkenfeld is 21,180, and the remainder is found in Oldenburg proper. The revenues of the state amount to about L.130,000 annually, arising partly from tolls on the Weser, and partly from taxes on foreign goods, but chiefly from domains. The state has no debt. The army consists of 1650 men; but the state is bound to contribute to the force of the German confederacy a contingent of 2177 men. The principal river is the Weser, into which the smaller streams flow, and it is the ordinary channel of marine commerce. The soil is in general poor and sandy, but near to the rivers there are some rich marshes, obtained by draining and embankments, which fatten cattle, and afford the productions of the dairy. The cultivation is badly conducted in the large division. There are a great number of small proprietors, who cultivate their own fields, and thereby procure a bare subsistence. The climate is raw, cold, and exceedingly variable.

OLDENBURG, a city, the capital of the duchy of the same name in the north-east of Germany. It is situated on the river Hunte, which is navigable to the Weser, and is surrounded with walls planted with lime trees, being well built and clean, but in an antique style. The duke has a large and old, but not an elegant palace, on the grand parade, adjoining to the city. The city contains two churches, two hospitals, and 660 houses, with 5420 inhabitants, who subsist chiefly from the expenditure of the court, of the tribunals, and of the civil officers of the government. It has little trade excepting at its two great fairs. Long. 8. 6. 1. E. Lat. 53. 8. 33. N.

OLDENBURG, *Henry*, was born in the duchy of Bremen, in Lower Saxony. During the long parliament, he was appointed consul for his countrymen, at London, after the usurpation of Cromwell; but being discharged of that employment, he was appointed tutor to the Lord Henry O'Bryan, an Irish nobleman, whom he attended to the university of Oxford, where he was admitted to study in the Bodleian Library in the beginning of the year 1656. He was afterwards tutor to William Lord Cavendish, and was acquainted with Milton the poet. During his residence at Oxford he became acquainted with the members of that body, which there gave birth to the Royal Society, upon the foundation of which he was elected a fellow; and when the society had found it necessary to have two secretaries, he was chosen as assistant secretary to Dr Wilkins. He applied himself with extraordinary diligence to the business of his office, and in the year 1664 began the publication of the *Philosophical Transactions*, which he continued to publish to No. xxxvi. 25th June 1677. After this the publication was discontinued till the January following, when it was again resumed by his successor in the office of secretary, Mr Nehemiah Grew, who carried it on till the end of February 1678. Mr Oldenburg died at his house at Charlcton, near Greenwich, in Kent, in August 1678.

OLDHAM, one of those towns which, within the present generation, have grown up with rapidity since the establishment of the cotton manufacture. It is situated in the hundred of Salford, in the county of Lancaster, eight miles from Manchester, and 186 from London. It stands on the river Medlock, very near the source of that and of another stream called the Irk, in a district abounding in coal. Oldham had been created into a market-town; and was by the reform act constituted a borough, with the power of returning two members to the House of Commons. It is parochially united with Prestwick, and these places comprehend ten townships, extending over 21,160 acres, with a population, in 1831, of 67,579 persons. The whole is a manufacturing district, making fustians and spinning cotton yarn, and also having a great trade in making hats. The town of Oldham is, for the most part, of very recent erection, containing many large piles of buildings destined for manufacturing purposes, and a proportional number of small dwellings for the workmen; but all are discoloured by the smoke which issues from numerous steam-engines, few of the proprietors of which reside within the town. It has a fine large parish church, and, as is usual with such a population, a very great variety of places of worship for the several discordant and dissenting sects. At the first election for this borough, it was distinguished by its selection of Mr Cobbett as one of its representatives. The population of the township of Oldham amounted in the year 1801 to 12,024, in 1811 to 16,690, in 1821 to 21,662, and in 1831 to 32,381.

OLDHAM, *John*, an eminent English poet of the seventeenth century, was educated under his father, a nonconformist minister, and then sent to Edmund Hall in Oxford. He afterwards became usher to the free school at Croydon in Surrey, where he received a visit from the Earls of Rochester and Dorset, Sir Charles Sedley, and other persons of distinction, merely on account of some verses of his which they had seen in manuscript. He was successively tutor to the sons of several gentlemen; and having saved a small sum of money, he came to London, where, being an agreeable companion, he became a perfect votary to the bottle. He was quickly found out by the noblemen who had visited him at Croydon, and who made him acquainted with Dryden. He lived mostly with the Earl of Kingston, at Holme Pierr-point, in Nottinghamshire, where he died of the small-pox in 1683, in the thirtieth year of his age. His acquaintance with learned authors appears, by his satires against the Jesuits, to have been considerable; and Dryden esteemed him highly. His works, which are printed in two vols. 12mo, consist chiefly of satires, odes, translations, paraphrases of Horace and other authors, elegiac verses, imitations, parodies, and familiar epistles.

OLDMIXON, JOHN, a violent party-writer and ill-natured critic, who would scarcely have been remembered, if Pope, in resentment of his abuse, had not condemned him to immortality in the Dunciad. His party-writings procured him a place in the revenue at Liverpool, where he died at an advanced age, in the year 1745. Besides his fugitive pieces, he wrote a History of the Stuarts, in folio; a Critical History of England, in two vols. 8vo; a volume of Poems; and some dramatic pieces.

OLEKMA, a river of Asiatic Russia, in the government of Irkoutsk, and a tributary of the Lena. Its course is from south to north, and is in length nearly 600 miles. The animal which produced the sable fur formerly haunted its banks, but it has now disappeared.

OLEKMINSK, a fort and small town of Asiatic Russia, in the government of Irkoutsk. It was originally erected as a station for collecting the tribute of furs from the Yakoutes, who wander in the neighbouring districts. It has some twenty houses and a church, and is situated about nine miles from the mouth of the Olekma. It is 692 miles north-east of Irkoutsk.

OLENEK, a considerable river of the government of Irkoutsk, in Asiatic Russia, which discharges itself into the Frozen Ocean. Long. 119. E. Lat. 73. N. The small town of Olensk is situated near the mouth of the Olenek.

OLENUS, a Greek poet, older than Orpheus, who was a native of Xanthe, a city of Lycia. He composed several hymns, which were sung in the island of Delos upon festival days. Olenus is said to have been one of the founders of the oracle at Delphi; to have been the first who at that place filled the office of priest of Apollo; and to have given responses in verse.

OLERON, an arrondissement of the department of the Lower Pyrenees, in France, being 972 square miles in extent. It comprehends eight cantons, which are divided into eighty-one communes, and it contains 71,400 inhabitants. The capital is the city of the same name, situated between the two rivers Gaves d'Aspe and Gaves d'Ossau. It contains 900 houses, and6400 inhabitants, who are employed in making thin woollen hosiery and leather. Long. 0. 17. W. Lat. 43. 10. N.

OLERON, an island situated on the coast of France, in the department of the Lower Charente. It is about ninety square miles in extent, and is opposite the mouths of the rivers Charente and Seudre. It is separated from the mainland by the strait called the Pertuis de Maubuisson. Oleron is a fertile spot, especially on the east and south parts, and yields good corn, wine, and brandy. There are also extensive marshes, from which salt is collected. It contains about 15,000 inhabitants, who are expert seamen and fishermen.

OLIGARCHY, a form of government in which the administration of affairs is confined to a few hands.

OLIO, or OGLIO, a savoury dish, or food, composed of a great variety of ingredients.

OLIVAREZ, DON GASPAR DE GUZMAN CONDE DE, the favourite and minister of Philip IV. of Spain, a man of great parts and boundless ambition. After a restless and unprincipled career, he was banished to Toro, where he died about the year 1645.

OLIVE'S ISLAND, a small island lying off the south coast of New Holland, and belonging to the Nuyts Archipelago. Long. 133. 53. E. Lat. 32. 46. S.

OLIVET, or MOUNT OF OLIVES, was situated to the east of the city of Jerusalem, and separated from the city only by the brook Kedron, and by the valley of Jehoshaphat, which stretches out from the north to the south.

OLIVETAN, ROBERT, a son of John Calvin. He printed, at Neufchatel, in 1535, folio, a version of the Bible into French, which had been translated from the original Hebrew and Greek. It is written in an uncouth and barbarous style, and is very far from being faithful. The characters in which it is printed are Gothic, and the language is scarcely less so. It is valued only because it is rare. Calvin is believed to have had a considerable share in this translation. Olivetan survived his publication only a short time. He died at Rome the year after, having, it is alleged, been poisoned on account of his translation. Olivetan's Bible, revised by Calvin and Malinger, was reprinted at Geneva, in 1540, in 4to. This edition is still rarer than the former. It is called the *Bible de l'Epée*, because the printer had adopted the figure of a sword as his ensign.

OLIVIER, CLAUDE MATTHIEU, advocate of the parliament of Aix, was born at Marseilles, in 1701. He had a principal share in the establishment of the academy of Marseilles, and was one of its original members. He practised at the bar with considerable success; and a few hours' retirement from society and from his pleasures were frequently sufficient to enable him to speak and write, even upon important causes. But his works commonly bore marks of great haste. Addicted to excess in every thing, he would employ a fortnight in studying the Code and the Digest, or in storing his mind with the beauties of Demosthenes, Homer, Cicero, and Bossuet; and would then abandon himself for another fortnight, frequently for a whole month, to a life of frivolity and dissipation. He died in 1736, at the age of thirty-five. Olivier published, 1. L'Histoire de Philippe Roi de Macedoine, et Père d'Alexandre le Grand, 2 vols. 12mo; 2. Mémoire sur les Secours donnés aux Romains par les Marseillois pendant la Seconde Guerre Punique; 3. Mémoire sur les Secours donnés aux Romains par les Marseillois durant la Guerre contre les Gaulois.

OLLERTON, a small market-town of the county of Nottingham, in the hundred of Bassetlaw, a part of the parish of Edwinston, of which it is a chapelry. It is 133 miles from London, and thirteen from Nottingham, and has a market, which is held on Friday. The population amounted in 1801 to 439, in 1811 to 462, in 1821 to 576, and in 1831 to 658.

OLMUTZ, a city of the Austrian province of Moravia, the capital of a circle of the same name, which extends over 2090 square miles, and comprehends twenty-seven cities, twenty market-towns, and 795 villages, with 410,000 inhabitants. It is for the most part a mountainous country, and the principal rivers of the province have their sources in it. The southern part is the least hilly, and is a very fertile and well-cultivated district. The city, which stands on the river March, is fortified, and defended by a citadel, in which Lafayette was long a prisoner. It is a well-built place, being the see of an archbishop, and the seat of the administration of the province; and it has a lyceum, with a good library, twenty-six professors, and about 800 students, who are admitted to graduate in the four faculties of law, philosophy, medicine, and theology. It contains 680 houses, and, besides the military, about 12,000 inhabitants. It has little trade, and none but small manufactories. Long. 14. 4. 45. E. Lat. 49. 32. 43. N.

OLNEY, a market-town in the hundred of Newport, in the county of Buckingham, fifty-six miles from London. It is built on the river Ouse, and consists chiefly of one long street. The only distinguished object is the parish church, a spacious building, with a spire 185 feet in height, being the most lofty of any in the county. There was formerly considerable occupation here for females in making bone lace; but it has nearly ceased, and been feebly replaced by making straw-plaiting for hats. This place was the residence of the poet Cowper, who drew much of his descriptions from the scenery around the town. There is a market on Monday, but it has much declined. The population amounted in 1801 to 2075, in 1811 to 2268, in 1821 to 2339, and in 1831 to 2418.

OLONEZ, a government or stadtholderate of Russia, so called from the city of the same name, and also the river which empties itself into the Lake of Ladoga. It extends in north latitude from 60. 29. to 66. 30., and in east longitude from 29. 45. to 41. 37., and has a superficies of 83,314 square miles. It is very thinly peopled, containing not more than 350,000 inhabitants. The southern part of the province is level, and abounds in lakes and morasses, including in the former the large Lake of Ladoga. In the northern part a portion of the Scandinavian range of mountains enters from Sweden and Norway. The soil is generally sterile, and the climate ungenial; but the former produces some rye, barley, and oats, though the harvests rarely afford four times the quantity of seed that is sown. The most important products, besides grain, are derived from the forests, which are extensive, and, besides fuel, supply timber for building, as well as tar and pitch. There are some few mines of iron worked, and the quarries yield marble and other kinds of stone, enormous blocks of which are conveyed to St Petersburg for building. The province is divided into eight circles, which contain eight cities and 227 parishes.

OLOT, a large town in the north-east of Spain, in the province of Catalonia and district of Vique. It is situated on the river Fluvia, about twenty miles to the north-west of the city of Gerona, so celebrated for its gallant defence against the French. It is surrounded with walls, is tolerably well built, with several squares, and contains three parochial and two conventual churches, besides a large hospital. In the town there are 3000 houses, and about 15,000 inhabitants, and it is one of the most industrious places in the kingdom. It is particularly distinguished by its manufactures of silk goods, and of cotton and woollen stockings. It has, too, several establishments for making serges and corduroys, as well as coarser woollens; some mills for spinning cotton, several tanneries, some printed cotton works, several soap-making manufactories, and a large manufactory of cards. It also has a considerable trade in cork and in wool. Notwithstanding it has suffered severely by the loss of the trade to South America, and by the internal political dissensions, it has made considerable progress in all branches of industry.

OLPAR, a town of Hindustan, in the province of Gujerat, and district of Broach, seven miles north from Surat. Long. 73. 1. E. Lat. 21. 18. N. It is also a small district, which was settled as a private estate on the peishwa, by the Mahratta treaty of 1803, but was afterwards taken from him on account of his treacherous conduct.

OLUTORA, a river of Asiatic Russia, which falls into the Eastern Ocean near the peninsula of Kamtschatka. A fort has been constructed by the Russians on its bank, but this has been twice destroyed by the Koriaks, a singular race, who take the whale in nets formed of thick ropes.

OLYMPIA, in *Ancient Geography*, was surnamed Pisatis, and so called from the territory of Pisa, in Elis. According to Strabo, there was here the temple of Jupiter Olympius, before which stood a grove of wild olive trees, in which was the stadium or foot-course, so called because it was the eighth part of a mile; and by it runs the Alpheus, which comes down from Arcadia. Olympia, however, was famous not merely for the temple of Jupiter, but also for a temple of Juno, sixty-three feet in length, with columns of the Doric order round it; and a metroum, or temple of the mother of the gods, a large Doric edifice, with holy treasuries. These, and the porticoes, gymnasium, prytaneum, and many more buildings, chiefly in the enclosure, with the houses of the priests and other inhabitants, rendered Olympia a place of no inconsiderable importance. The stadium was in the grove of wild olive trees, before the great temple; and near it was the hippodrome, or course for the races of horses and chariots. The Alpheus flowed by from Arcadia, in a copious and pleasant stream, which was received on the coast by the Sicilian Sea.

The temple of Jupiter was of the Doric order, sixty-eight feet in height to the pediment, ninety-five in width, and two hundred and thirty in length; the cell being encompassed with columns. It was erected with the stone of the country; but the roof was of Pentelican marble, the slabs being disposed as tiles, and the access to it was by a winding staircase. The two pediments were enriched with sculpture, one having over the centre a statue of Victory gilded, and underneath a votive buckler of gold. At each corner there was a gilded vase. Above the columns were fixed twenty-one gilded bucklers, offered at the conclusion of the Achæan war by the Roman general Mummius. The gates in the two fronts were of brass, and over them were carved the labours of Hercules. Within the cell were double colonnades, between which was the approach to the image.

The Jupiter of Olympia was accounted alone sufficient to immortalize its sculptor Phidias. It was of ivory and gold, and the head was crowned with olive. In the right hand was a statue of Victory; and in the left a flowered sceptre, composed of various metals, and on which was an eagle. The sandals were of gold, and the vestment was of the same material, being curiously embossed with lilies and animals. The throne was gold inlaid with ebony and ivory, and studded with jewels, intermixed with paintings and exquisite figures in relief. The pillars between the feet contributed to its support. Before it were walls, serving as a fence, and decorated principally with the exploits of Hercules; the portion opposite to the door was of a blue colour. A family descended from Phidias, and called *phædruntæ*, or *the polishers*, had the charge of keeping the work bright and clean. The veil or curtain was of cloth rich

Olympiad ‖ Olympic Games.

with the purple dye of Phœnicia, and worked with Assyrian embroidery; an offering of King Antiochus, and which was let down from above by loosening the strings. The image impressed the spectator with an opinion that it was wider and higher than it actually measured. Its magnitude was such, that, though the temple was very large, the artist seemed to have erred in the proportions. The god, sitting, nearly touched the ceiling with his head, and thus suggested an idea that, if he were to rise up, he would destroy the roof. A part of the pavement before it was of black marble, enclosed in a rim of Parian or white marble, within which they poured oil to preserve the ivory.

The altar of Jupiter Olympius was of great antiquity, and composed of the ashes of the thighs of the victims, which were carried up and consumed on the top of it, along with wood of the white poplar tree. The ashes also of the prytaneum, in which a perpetual fire was kept burning on a hearth, were removed annually on a fixed day, and spread upon it, being first mingled with water from the Alpheus. The cement, it was affirmed, could be made of that fluid only, and therefore this river was much respected, and esteemed the most friendly of any to the god. On each side of the altar there were stone steps, and its height was about twenty-two feet. Women and girls, when allowed to visit Olympia, were suffered to ascend the basement, which was an hundred and twenty-five feet in circumference. The people of Elis sacrificed daily, and private persons as often as they chose. Olympia was situated upon an eminence, between two mountains called Ossa and Olympus.

OLYMPIAD, the space of four years, by which the Greeks reckoned time. According to the most accurate and learned computation of the moderns, the first Olympiad fell exactly 776 years before the first year of Christ, or 775 years anterior to his birth, in the year of the Julian period 3938, and twenty-two years before the building of the city of Rome. The games were exhibited at the time of the full moon next after the summer solstice; therefore the Olympiads were of unequal length, because the time of the full moon differs eleven days every year; for which reason they sometimes began the next day after the solstice, and at other times four weeks afterwards. The computation by Olympiads ceased, as some suppose, after the 304th, in the year 440 of the Christian era. It was universally adopted, not only by the Greeks, but by many of the neighbouring countries; though the Pythian games still served as an epoch to the people of Delphi and to the Bœotians, the Nemæan games to the Argives and Arcadians, and the Isthmian to the Corinthians and the inhabitants of the isthmus. To the Olympiads history has been greatly indebted. They have served to fix the time of many momentous events; and indeed before this method of computing time was observed, every page of history is mostly fabulous, being filled with such obscurity and contradiction, that no true chronological account can be properly established or maintained with certainty.

OLYMPIC GAMES were solemn games amongst the ancient Greeks, and so called from Olympian Jupiter, to whom they were dedicated. By some they are said to have been first instituted by him after his victory over the sons of Titan; whilst others ascribe their institution to Hercules (not the son of Alcmena, but one of much greater antiquity), others to Pelops, and others to Hercules the son of Alcmena. The festival, which lasted five days, began and ended with a sacrifice to Olympian Jupiter. The intermediate time was chiefly filled up by the gymnastic exercises, in which all freemen of Grecian extraction were invited to contend, provided they had been born in lawful wedlock, and had lived untainted by any infamous or immoral conduct. The preparation for this part of the entertainment was made in the gymnasium of Elis, a spacious edifice surrounded by a double range of pillars, with an open area in the middle. Adjoining were various apartments, containing baths, and other conveniences for the combatants. The neighbouring country was gradually adorned with porticoes, shady walks, and groves, interspersed with seats and benches; the whole being originally destined to relieve the fatigues and anxiety of the candidates for Olympic fame, and frequented in later times by sophists and philosophers, who were fond to contemplate wisdom and communicate knowledge in those delightful retreats. The order of the athletic exercises, or combats, was established by Lycurgus, and corresponded almost exactly to that described by Homer in the twenty-third book of the Iliad, and the eighth of the Odyssey. Iphitus, we are told, appointed the other ceremonies and entertainments; settled the regular return of the festival at the end of every fourth year, in the month of July; and gave to the whole solemnity that form and arrangement which it preserved with but little variation for more than a thousand years; a period exceeding the duration of the most famous kingdoms and republics of antiquity. Amongst the benefactors of Olympia at a much later period was reckoned Herod, afterwards king of Judæa. On his way to Rome, seeing the games neglected or dwindling into insignificance, from the poverty of the Eleans, he displayed great munificence as president, and provided an ample revenue for their future support and dignity. Such an institution, even in its least perfect form, must have been attended with advantages to society. It is sufficient to mention the suspension of hostilities which took place, not only during the celebration of the festival, but for a considerable time both before and after it. Considered as a religious ceremony, to which the whole Grecian race was invited, and even enjoined to assist in its celebration, it was well adapted to facilitate intercourse, to promote knowledge, to soften prejudice, and to accelerate the progress of civilization. Greece, particularly Peloponnesus, was the centre from which the adventurous spirit of its inhabitants had diffused innumerable colonies throughout the surrounding nations. To these widely-separated communities, which, notwithstanding their common origin, seemed to have lost all connection and correspondence, the Olympiad served as a common bond of alliance and a point of re-union. The celebrity of this festival continually attracted to it the characters most distinguished for genius and enterprise, whose fame would have otherwise been unknown and lost in the extent of the Grecian territory. The remote inhabitants, not only of European Greece, but of Asia and Africa, being assembled at the worship of their common gods, were thus trained to the sense of a general interest, and excited to the pursuit of national honour and prosperity. Strangers of similar dispositions might confirm in Elis the sacred and indissoluble ties of hospitality. If their communities were endangered by any barbarous power, they might there solicit assistance from their Grecian brethren; and, upon other occasions, they might explain the benefits which, in peace or war, their respective countries were best qualified to communicate. And thus the Olympic festival might serve the purpose of resident ambassadors, and of other institutions alike unknown to antiquity.

Om ‖ Omar Ebn al Khattab.

OM, a considerable river of Tobolsk, in Asiatic Russia, which rises in a lake, and, after a western course of about 500 miles, falls into the Irtysch.

OMA, one of the Molucca Islands, about nine miles in length and six in width, containing about 5000 inhabitants.

OMAR EBN AL KHATTAB, the successor of Abu-Bekr. We are informed that Omar was miraculously converted to the Mahommedan faith. Before this event he is said to have been truly respectable, and in particular a violent opposer of the Arabian prophet. Mahommed, it seems, felt this opposition, and regretted it; he, therefore, with all the fervour, and, as it happened, with all the success of a true prophet, as his followers pretend, prayed for the conversion of his dangerous antagonist. Omar is said to have no sooner read the twentieth chapter of the Koran than he was convinced; upon which he instantly repaired to Mahommed and his followers, and declared his conversion. On the death of Abu-Bekr, who had succeeded the impostor himself, he was promoted to the regal and pontifical dignity. The title first assigned him was the "caliph of the caliph of the apostle of God;" or in other words, "the successor of the successor of Mohammed;" but the Arabs, considering that this title, by the addition to be annexed to it at the accession of every future caliph, would be too long, they, by universal consent, saluted him "the emperor of the believers;" which illustrious title, conferred at this juncture upon Omar, descended afterwards to all the successors of that prince. He was assassinated by a Persian slave, who stabbed him in the mosque at Medina. This event took place in the twenty-third year of the Hegira, which began in the year of Christ 643. His extensive conquests rendered the Moslem empire one of the most powerful and formidable monarchies in the world.

OMBAY, an island in the Eastern Seas, forty-five miles in length and about thirteen in breadth. Its inhabitants are fierce and treacherous in their habits, so that it is dangerous for strangers to approach it. It is twenty miles west of Timor.

OMBRE, a well-known game at cards, borrowed from the Spaniards, and played by two, by three, or by five persons, but generally by three. When three play at this game, nine cards are dealt to each party; the whole ombre pack being only forty, because the eights, nines, and tens are thrown out of the pack. There are two sorts of counters for stakes, the greater and the lesser. The last has the same proportion to the other as a penny has to a shilling. Of the greater counters each man stakes one for the game; and one of the lesser for passing for the hand, when eldest, and for every card taken in. As to the order and value of the cards, the ace of spades, called *spadillo*, is always the highest trump, in whatsoever suite the trump be; the *manille*, or black deuce, is the second; and the *basto*, or ace of clubs, is always the third. The next in order is the king, the queen, the knave, the seven, the six, the five, four, and three. Of the black there are eleven trumps, and of the red, twelve. The least small cards of the red are always the best, and the most of the black, except the deuce and red seven, both of which are called the *manilles*, and are always second when the red is a trump. The red ace, when a trump, enters into the fourth place, and is called *punto;* otherwise it is only called an ace. The three principal cards are called *matadores*, and have this privilege, that they are not obliged to attend an inferior trump when it leads; but, for want of a small trump, the person may renounce small trumps, and play any other card; and when these are all in the same hand, the others pay three of the greatest counters a piece. With these three for a foundation, the player may count as many matadores as he has cards in an uninterrupted series of trumps; and for all these the others are to pay one counter a piece. He who has the first hand is called *ombre*, and has his choice of playing the game, of naming the trump, and of taking in as many or as few cards as he pleases; and after him the second, &c. But if he does not name the trump before he looks on the card which he has taken in, any other may prevent him, by naming what trump he pleases. He who has the first hand should neither take in nor play, unless he has at least three sure tricks in his hand; for, as he wins the game who wins most tricks, he that can win five of the nine has a sure game. This is also the case if he win four, and can so divide the tricks that one person may win two, and the other three.

If a person play without discarding or changing any of the cards, this is called playing *sans prendre;* and if another win more tricks than he, he is said to win *codille.* The oversights in the course of the game are called *beasts;* and if the ombre wins all the nine tricks, it is called winning the *vole.*

In ombre by five, which many, on account of its not requiring so close an attention, prefer to that by three, only eight cards a piece are dealt; and five tricks must be won, otherwise the ombre is beasted. Here the person who undertakes the game, after naming the trump, calls a king to his assistance; upon which the person in whose hand the king is, without discovering himself, is to assist him as a partner, and to share his fate. If, between both, they can make five tricks, the ombre wins two counters, and the auxiliary king only one; but when the counters are even, they divide them equally. If the ombre venture the game without calling in any king, this too is called playing *sans prendre;* in which case the other four are all against him, and he must win five tricks alone, or be beasted. The rest is much the same as by three.

OMBROMETER, an instrument to measure the quantity of rain that falls. It consists of a tin funnel, the surface of which is an inch square, with a flat board, and a glass tube set into the middle of it in a groove. The rise of the water in the tube, the capacity of which at different times must be measured and marked, shows the quantity of rain that has fallen.

OMEERSEER, a village of Hindustan, in the province of Cutch, about four miles south from Luckput Bunder. Lat. 23. 43. N.

OMELET, or OMELETTE, a kind of pancake or fricassée of eggs, with other ingredients, very common in Spain and in France.

OMEN is a word which, in its proper sense, signifies a sign or indication of some future event, taken from the language of a person speaking without any intention to prophecy. Hence Tully says that the Pythagoreans attend to the discourse, not only of gods, but also of men, which they call *omens.* This sort of omen was supposed to depend much upon the will of the person concerned in the event; and hence the phrases, *accepit omen, arripuit omen.* Such were the original omens: but they were afterwards derived from things as well as from words. Thus Paterculus, speaking of the head of Sulpicius on the rostrum, says it was *velut omen imminentis proscriptionis*, the omen of an impending proscription. Suetonius observes of Augustus, that he believed implicitly in certain omens; and that if his shoes were improperly put on in the morning, especially if the left shoe was put upon his right foot, he considered it as a bad omen. Omen was used, in a still larger sense, to signify an augury, as in the following line of Tully: "Sic aquilæ clarum firmavit Jupiter *omen*," thus Jove confirmed the bright omen of the eagle. Lastly, it was used, in the most generic sense of all, for a portent or prodigy; as in the third book of the Æneid, where a myrtle torn up by Æneas dropped blood.

The portentous or supernatural omens were either external or internal. Of the former kind were those showers of blood so frequently occurring in the Roman history, which were much of the same nature with this adventure of Æneas, which he calls *monstra deum.* Of the latter kind were those sudden consternations, which, seizing upon men without any visible cause, were imputed to the agency of the god Pan, and hence called *panic terrors.* But indeed there was hardly any thing, however trivial, from which the ancients did not draw omens. That it should have been thought a direful omen when any thing befell the temples, altars, or statues of the gods, need therefore excite no wonder; but that the meeting of an eunuch, a negro, a bitch with whelps, or a snake lying on the road, should have been looked upon as portending bad fortune, is a deplorable instance of human weakness, and of the pernicious influence of superstition on the mind.

It is more than probable that this practice of making ordinary events ominous of good or bad fortune took its rise in Egypt, the parent land of almost every superstition; but wherever it may have arisen, it spread itself over the whole inhabited globe, and at this day prevails in a greater or less degree amongst the vulgar of all nations. The following may be cited as examples.

To break a looking-glass is extremely unlucky; the party to whom it belongs will lose his best friend. If, going a journey on business, a sow cross the road, you will probably meet with a disappointment, if not a bodily accident, before you return home. To avert this you must endeavour to prevent her crossing you; and if that cannot be done, you must ride round on fresh ground. If the sow be attended with her litter of pigs, it is lucky, and denotes a successful journey. It is unlucky to see first one magpie, and then more; but to see two denotes marriage or merriment; three, a successful journey; four, an unexpected piece of good news; and five, that you will shortly be in a great company. To kill a magpie will certainly be punished with some terrible misfortune. If in a family the youngest daughter should be married before her elder sisters, they must all dance at her wedding without shoes. This will counteract their ill luck, and procure them husbands. If you meet a funeral procession, or if one pass by you, always take off your hat. This keeps all the evil spirits attending the body in good humour. If, in eating, you miss your mouth, and the victuals fall, it is very unlucky, and denotes approaching sickness. It is lucky to put on a stocking the wrong side outwards; changing it alters the luck. When a person goes out to transact any important business, it is lucky to throw an old shoe after him. It is unlucky to present a knife, scissors, razor, or any sharp or cutting instrument, to one's mistress or friend, as they are apt to cut love and friendship. To avoid the evil effects of this, a pin, a farthing, or some trifling recompense, must be taken. To find a knife or razor denotes ill luck and disappointment to the party that finds it.

OMER, St, an arrondissement of the department of the Pas de Calais, in France. It extends over 450 square miles, and comprises seven cantons and 136 communes, with 105,020 inhabitants. The capital is the city of the same name, situated on the river Aa. It has walls, broad streets, and well-built houses, a cathedral, six churches, a college, 2100 houses, and 19,032 inhabitants. It is a place of considerable manufactures of woollens, and where, by means of a canal connecting it with the city of Calais, there is a great internal trade in agricultural products. Long. 2. 9. 52. E. Lat. 50. 44. 52. N.

OMERCUNTUC, a district and town of Hindustan, in the province of Gundwana. It is a celebrated resort of Hindu pilgrimage. In the neighbourhood are found the sources of the three great rivers, the Soane, Nerbuddah, and the Mahanuddy, which adds to the sanctity of the place; the Hindus always evincing a great regard for the sources and the confluence of rivers. Long. of the town 82. 15. E. Lat. 22. 53. N.

OMERPOOR, a town of Hindustan, in the nizam's territories, in the province of Berar, eighty-two miles north-east from Julnapoor. Long. 77. 10. E. Lat. 20. 23. N.

OMMON, a district of Arabia, which comprises a portion of the southern coast extending from its eastern extremity of Rasalgate to the entrance of the Persian Gulf. In the interior it is one of the wildest parts of the country, and is little known, but is generally supposed to consist of sandy deserts. Along the coast the country is more fertile, and the inhabitants are an industrious and active race, pursuing with ardour both commerce and navigation. The soil is well watered by the rivers which flow from the ranges of mountains along the coast. Its produce is confined almost exclusively to dates and a little wheat, which appears to be scarcely sufficient for its own consumption, as, according to Frazer (see Narrative of a Journey into Khorassan, p. 17), large quantities of the latter article are imported from Bushire and Bassora. On the other hand, large quantities of dates are also exported; those of Ommon enjoying, it is said, a preference over the produce of other places, particularly in Sinde, to which they are exported. Dates are the great staple of these countries, being the staff of life; and they are the standard by which the value of landed estates is estimated. Landed property, although it usually descends by inheritance, may be disposed of in any way the proprietor pleases. The sovereign's claim is confined to the tenth of the produce, and he can in no way interfere with the proprietor's rights, although he may divest him of any command which he possesses, or expel him from the district if he pleases. Lands are usually let out in lease, or annual rent payable in a portion of the produce. Slaves are made use of here, as throughout Arabia, in the labours of agriculture; but they are treated with kindness and indulgence. The property of the Arabs which they possess independently of land, consists for the most part in live stock, sheep, goats, camels, asses, a few horses, and cows; camels being in value from thirty to three hundred dollars a-piece, according to blood and quality. The asses of Ommon are celebrated as the finest of Arabia; and individuals of the best breed sell for very extravagant sums. The value of the common kind varies from one to forty dollars; goats from four to six dollars; sheep from one and a half to six dollars. No mules are reared, nor are horses abundant in the province. The cows have humps, and resemble those of India. Milk, butter, and ghee are very abundant, and good of their kinds; which is the more remarkable, as the cattle have little or no pasture in the neighbourhood, and are fed upon dried fish a little salted, of which they become very fond. Ommon is by no means celebrated for its manufactures, which consist of turbans and waistbands, or girdles of cotton and silk, striped or checked with blue, and having the ends ornamented with red, green, or yellow borders; cloaks, called abbas, made of sheep's wool or camel's hair, and of various degrees of fineness; cotton canvass, gunpowder, and arms of no superior quality; and earthen jars for the market of Zanguebar. They also prepare a sweetmeat in high esteem, called *hulwak*, from honey or sugar, the gluten of wheat and ghee, with a few almonds; and sharks' fins and dried salt-fish for the eastern markets. Frazer states, that the provinces of Arabia, of which Muscat is the first, are too poor to consume much foreign produce, or to afford any considerable quantity of their own in exchange. Still, he adds, there is a certain demand for many Indian productions and other articles, as rice, sugar, spices, cotton cloths, silk, indigo, ship timber, and coffee from Mocha, cowries, ivory, Joarree grain, gums, civet oil for burning, cocoa-nuts, wood for building, and slaves from Zanguebar and other African ports; dates, rose-water, &c. from Bushire and Bassora. A considerable quantity of these articles is sent to this country merely in transit, as it is a great entrepôt of the commerce which is carried on between India, Arabia, Persia, and Eastern Africa; but no inconsiderable portion is consumed in the country, and paid for chiefly in dollars and cowries; and he is at a loss to understand where this quantity of specie is procured. But it is obvious that the country can only procure it by the sale of its own produce. There is no other source from which it can be obtained; nor need a passing traveller be surprised that he cannot comprehend at a glance all the resources which an extensive district may possess for carrying on foreign trade. Where can any country find equivalents to exchange with foreigners for their produce but within itself? The fact stated by Mr Frazer, of the abundance of specie given in exchange for foreign articles, speaks for itself. It is an index of the state of wealth; nor need it excite the smallest incredulity or surprise. The climate of Ommon is extremely unfavourable for European constitutions; scarcely any native of Europe ever resides here without experiencing its fatal effects. The heat is always great. Frazer mentions, that during his abode there, which was in July, the heat varied from 90° to 102° of Fahrenheit; the greatest inconvenience experienced was from the suffocating heat of the nights, as a parching wind blew from the rocks, preventing that cool freshness which the dewy morning brings in most countries, and keeping the frame so continually relaxed and unrefreshed by sleep, as to render it predisposed to the attacks of disease. The natives are the most expert navigators in these seas, and use a very singular species of craft, which are broad in proportion to their length, and are constructed of planks fastened together by nails, and tied and sewed together with cords. This country was early invaded by the Portuguese, who acquired possession of Muscat, its principal port, which they retained for nearly two centuries. Ommon was invaded and conquered, in the course of the last century, by Nadir Shah. But the native princes, when his armies were engaged in other quarters, took the opportunity of re-conquering their dominions, which they have ever since retained. The chief towns are Rostak, the residence of the imaum; Muscat, which is chiefly known to Europeans; and Kalhat and Sohar.

The country is ruled by a supreme chief or imaum, who, besides, holds in possession the islands of Keshmee and Ormuz in the gulf, and rents from the court of Persia Gomberoon, and Binderabbassec and its dependencies, including the district of Juroom, which extends from Meenab, on the south-east, to Khumeer, on the north-west, including about eighty miles of sea-coast. His revenues are derived from various sources. He receives a tenth part of the produce of the territories of Ommon, which is trifling; a duty of a half per cent. on all merchandise passing up the gulf on Arab bottoms, amounting, according to Frazer's estimate, to 160,000 dollars a year; the rents of valuable sulphur mines, which he holds of the Persian government; and considerable landed property in the country of Ommon, which brings him in only some thousands of dollars in the year. Commerce is perhaps the chief source of his income. He possesses five fine ships, his private property, two of them mounting fifty and forty guns respectively, besides four other vessels such as are used on the Arabian coast. His vessels trade to all parts of India and the East, to the coasts of Arabia and Africa, to Madagascar and the Mauritius, besides the ports of the Persian Gulf.

OMOA, a Spanish town and fortification on the southern side of the Bay of Honduras. Long. 89. 50. W. Lat. 15. 50. N.

OMOPHAGIA, an ancient Greek festival in honour of Bacchus, surnamed *Omophagos*, or the eater of raw flesh. This festival was observed in the same manner with the other festivals of Bacchus, in which the celebrants counterfeited madness. What was peculiar to it was, that the worshippers used to eat the entrails of goats, raw and bloody, in imitation of the god, who was supposed to have done the same thing.

OMPHALE, in fabulous history, a queen of Lydia, the daughter of Jardanus. She married Tmolus, who at his death left her mistress of his kingdom. Omphale having been informed of the great exploits of Hercules, wished to see so illustrious a hero; and her wish was soon gratified. After the murder of Eurytus, Hercules fell sick, and was ordered to be sold as a slave, that he might recover his health and the right use of his senses. Mercury was commissioned to sell him, but Omphale bought him, and restored him to liberty. The hero became enamoured of his mistress, and the queen having favoured his passion, had a son by him, whom some call Agelaus, and others Lamon. From the son in question were descended Gyges and Crœsus; but this opinion is different from the account which represents these Lydian monarchs as having sprung from Alcæus, a son of Hercules by one of the female servants of Omphale. Hercules is represented by the poets as so desperately enamoured of the queen, that, to conciliate her esteem, he span by her side amongst her women, whilst she covered herself with the lion's skin, seized the club of the hero, and often struck him with her sandals for the uncouth manner in which he held the distaff.

OMRATTEE, a large, fortified, and trading town of Hindustan, in the province of Berar. It carries on an extensive trade in cotton, which is sent to Mirzapore by land carriage, a distance of 500 miles, and is sold in this celebrated mart for quadruple its original cost. Long. 78. 20. E. Lat. 20. 59. N.

OMREE, a town of Hindustan, in the province of Berar, belonging to the nizam. Long. 77. 64. E. Lat. 21. 7. N.

OMSK, a town of Asiatic Russia, in the government of Tomsk, situated at the junction of the river Om with the Irtysch. It is intended as a barrier against the incursions of the Kirghises. It is an agreeable town, and the general's house, the church, and the military school, are handsome edifices. It has always a garrison, and the inhabitants amount to 800. It is deficient in a supply of wood, which the coldness of the climate renders almost a necessary of life. The original fort was built in 1716, but was transferred to its present site in 1766. Long. 74. 54. E. Lat. 55. 4. N.

OMUDWARA, a district of Hindustan, in the Mahratta territories, and province of Malwah. It is a wild and uncultivated country, much covered with jungle; but where cultivated it is of great fertility, being intersected by the Sopra and Gilligsind Rivers.

ON, in *Ancient Geography*, a city of ancient Egypt, sacred to the sun, and on that account called by the Greeks *Heliopolis*. It was remarkable for the wisdom and learning of its priesthood, and for the spacious building in which they cultivated the studies of philosophy and astronomy. The priests of On were esteemed more noble than all the other priests of Egypt. They were always privy councillors and ministers of state; and therefore, when Pharaoh resolved to make Joseph his prime minister, he very wisely gave him in marriage a daughter of the priest of On, thereby incorporating him into the most venerable caste in Egypt. Bishop Warburton thinks that the superior nobility of the priests of On was chiefly owing to their high antiquity and great learning. That they were much addicted to the study of astronomy, we know from the testimony of Strabo; and indeed nothing is more probable than that they should have been attached to the study of that system over which their god, the Sun, presided, not only in his moral, but also in his natural capacity. The learned prelate affirms, that whether they received the doctrine from original tradition, or invented it at hazard, which last supposition he thinks more probable, it is certain they taught that the Sun is in the centre of its system, and that all the other bodies move round it in perpetual revolutions. "This noble theory," he continues, "came with the rest of the Egyptian learning into Greece (being brought thither by Pythagoras, who received it from Œnuphis a priest of On); and after having given the most distinguished lustre to his school, it sunk into obscurity, and suffered a total eclipse throughout a long succession of learned and unlearned ages, till these times restored its ancient splendour, and immoveably fixed it on the unerring principles of science."

ONATEYA, or ONATIAYO, one of the Marquis of Mendoza's Islands, about five leagues to the east of Ohittahoo. It is three leagues in circumference, and of moderate elevation, with extensive woods and plantations. Long. 138. 55. E. Lat. 9. 55. S.

ONEEHOW, one of the Sandwich Islands, in the North Pacific Ocean, about forty miles in circumference. It contains abundance of yams, and a sweet root used by the inhabitants. The population is estimated at about 10,000.

ONEGA, a city of European Russia, in the province of Archangel. It is the capital of a circle of the same name, both so called from the river which waters a great part of the district, and at the mouth of which the city has been built. It is a small but well-built town, containing less than 2000 inhabitants, who subsist by trading in timber, pitch, and tar, and by exporting oats in some seasons to Norway. It has some trade in ship-building. It is about eighty miles from Archangel, and 916 from St Petersburg. Long. 38. 7. 40. E. Lat. 63. 53. 36. N.

ONEGA, a river and lake of the Russian empire. It is a hundred miles in length and forty in breadth, having a communication with the lake Ladoga, and consequently with St Petersburg. The river, which has its source in Cargapol, and gives its name to a country full of woods, falls into the White Sea.

ONEGLIA, a district of the province of Nice, in the kingdom of Sardinia, bounded on the south-east by the Gulf of Genoa, and on the other sides by the territory forming a part of that ancient republic. It is about ninety square miles in extent, and is almost covered with olive trees, which yield abundance of oil; besides which, wine, figs, silk, flax, and some corn, are produced. It was formerly considered as a principality, and gave the title of prince to the family of Doria. The principality was divided into three valleys; Oneglia, Maro, and Prela. The capital, bearing the name of the district, is about one mile to the eastward of Port Maurice, and a mile and three quarters from Cape Verde. It stands upon a plain on the sea-shore, and the river Impero falls into the Mediterranean Sea on its western side. It is surrounded with walls, and defended by three forts; one in the centre, and one at each end. The anchorage-ground is good, but open to the prevailing winds. There are several religious houses for both sexes, a gymnasium, and a governor's palace. It contains about 4000 inhabitants. Long. 8. 2. E. Lat. 43. 53. N.

ONEIROCRITICA, the art of interpreting dreams, or a method of foretelling future events by means of dreams. The word is formed from the Greek ὀνειρος, *a dream*, and κριτικη, from κρισις, *judgment*. Some call it *oneirocratica*, and derive it from ὀνειρος, *a dream*, and κρατεω, *I possess*, or *I command*. It appears from several passages of Scripture, that, under the Jewish dispensation, there was such a thing as foretelling future events by dreams; but then a particular gift or revelation was expressly required for that purpose. Hence it has been inferred, that dreams are really significative, and forebode something to come; and all that is wanting amongst us is the *oneirocritica*, or the art of knowing what they foreshow. Yet it is the opinion of many that dreams are mere chimeras, bearing indeed some relation to what has passed, but none at all to what is to come. As to the case of Joseph, it was possible for God, who knew all things, to discover to him what still remained hidden in the womb of fate; and to introduce that disclosure, he might take the occasion of a dream.

ONEIROCRITICS, a title given to the interpreters of dreams, or those who judged of events from the circumstances of dreams. No great regard is to be paid to those Greek books called *oneirocritics;* nor do we know why the patriarch of Constantinople, and others, should have amused themselves with writing on so pitiful a subject. Rigault has given us a collection of the Greek and Latin works of this kind; one attributed to Astrampsichus, and another to Nicephorus, patriarch of Constantinople; and to these are added the treatises of Artemidorus and Achmet. But the books themselves are little else than reveries; a kind of waking dreams, to explain and account for sleeping ones. According to them, all the secrets of oneirocriticism consists in the relation supposed to exist between the dream and the thing signified; but they are far from keeping to the relations of agreement and similitude, and frequently have recourse to others of dissimilitude and contrariety. Concerning oneirocritics and oneirocritica, the unlearned reader will find much information in Warburton's Divine Legation of Moses, and in the works to which he refers.

ONEVY, one of the Friendly Islands, in the Southern Pacific Ocean, near the north coast of Tongataboo.

ONGOLE, a district and town of Hindustan, in the province of the Carnatic, situated between the 15th and 16th degrees of north latitude. It was formerly dependent upon the principality of Cuddapah, and was afterwards incorporated with the Carnatic below the Ghauts, and in consequence came under the dominion of the nabob of Arcot, by whom it was transferred to the British in 1781. The principal rivers are the Mussy and the Gondegamma; and the chief towns are Ongole, Courchier, and Sintalsheroo. Ongole was formerly a fortified town; but the fortifications, owing to the tranquil state of the country, have now been allowed to go to decay. It is 173 miles north by west from Madras. Long. 81. 1. E. Lat. 15. 31. N.

ONGOLOGUR, a town of Hindustan, possessed by independent zemindars, in the province of Orissa, fifty-five miles west from Cuttack. Long. 85. 20. E. Lat. 20. 36. N.

ONKELOS, surnamed the *Proselyte*, a famous rabbi of the first century, and author of the Chaldaic Targum on the Pentateuch. He flourished in the time of Jesus Christ, according to the Jewish writers, who all agree that he was, at least in some part of his life, contemporary with Jonathan Ben Uzziel, author of the second Targum upon the prophets. Prideaux thinks that he was the elder of the two, for several reasons, the chief of which is the purity of the style of his Targum, in which it comes nearest to that part of Daniel and Ezra which is in the Chaldaic, and being the truest standard of that language, is consequently the most ancient, since that language, as well as others, was in a constant fluctuation, and in every age continued deviating from the original. Nor does there appear to be any reason why Jonathan Ben Uzziel, when he undertook his Targum, should pass over the law, and begin with the prophets, except it be that he found Onkelos had done this work before him, and with a success which he could not exceed.

Azarias, the author of a book entitled *Meor Enaim*, or the "light of the eyes," tells us, that Onkelos was a proselyte in the time of Hillel and Samnai, and lived to see Jonathan Ben Uzziel, one of the prime scholars of Hillel. These three doctors flourished twelve years before Christ, according to the chronology of Gauz, who adds, that Onkelos was contemporary with Gamaliel the elder, St Paul's master, who was the grandson of Hillel. However, he same Gauz, by his calculation, places Onkelos a hundred years after Christ, and, in order to adjust his opinion with that of Azarias, extends the life of Onkelos to a great length. The Talmudists tell us that he assisted at the funeral of Gamaliel, and was at a prodigious expense to render it magnificent. Prideaux observes, that the Targum of Onkelos is rather a version than a paraphrase, since it renders the Hebrew text word for word, and for the most part accurately and exactly, and is by far the best of the kind; wherefore it has always been held amongst the Jews in much greater esteem than the other Targums; and being set to the same musical notes with the Hebrew text, is thereby capable of being read in the same tone with it in their public assemblies. From the excellency and accuracy of the Targum of Onkelos, Prideaux also concludes that he must have been a native Jew, since, without having been bred up from his birth in the Jewish religion and learning, long exercised in all the rites and doctrines of both, and being also thoroughly skilled in both the Hebrew and Chaldaic languages, as far as a native Jew could be, he could scarcely have been thoroughly adequate to the work which he executed. The same author also thinks, that the representing him as a proselyte may have proceeded from the error of supposing him to have been the same with Akilas or Aquila of Pontus, author of the Greek Targum or version of the prophets and Hagiographia, and who was indeed a Jewish proselyte.

ONOMANCIA, or rather ONOMANTIA, a branch of divination, which foretells the good or bad fortune of a man from the letters in his name. Upon much the same principle the young Romans were accustomed to toast their mistresses as often as there were letters in their names. Hence Martial says,

Nævia sex cyathis, septem Justina bibatur.

ONOMATOPOEIA, in grammar and rhetoric, a figure where words are formed to resemble the sound emitted by the things signified; as the buzz of bees, the cackling of hens, or the note of the cuckoo. Resemblances of this kind are often fancied when they are not real; though, no doubt, there are in every language some words of which the sound is very like to that which those words are employed to express. Yet, to the mortification of grammarians and rhetoricians, conjunctions, which have been pronounced to be no parts of speech at all, are the only sounds uttered by men which are wholly natural, and these are fewer than is commonly supposed.

ONON, a large river of Asiatic Russia, upon the frontier of Chinese Tartary, which has its rise amongst the interior mountains, and flows north-east till it forms the Chilka, which afterwards discharges itself into the Amour. The rude tribes of the Bannats and Tungusses wander along its banks.

ONONDAGA, a post township and capital of Onondaga county, New York, a hundred and thirty miles west-north-west of Albany, and fifty miles west of Utica. It is ten miles in length by nine in breadth. Through the eastern part a broad valley extends north and south, bounded on each side by high swelling ridges. This valley, which is of rich alluvion and exuberant fertility, is watered by Onondaga Creek, which flows northward to Onondaga Lake, in the town of Salina. The post borough of Onondaga, the seat of the county buildings, is situated on a delightful eminence. The post village of Onondaga Hollow stands about one mile east of the court-house. It has an arsenal belonging to the state, and many mechanical establishments. Onondaga Castle is the chief town of the remnant of the Onondaga tribe of Indians, after whom the township has been named. It is situated three miles south of the village of Onondaga Hollow, and contains about fifty Indian houses, which are built of logs. There are about a hundred and forty persons, who annually receive a thousand dollars from the state of New York. The whole township of Onondaga in 1831 contained 5668 inhabitants, and it does not seem to be rapidly increasing.

ONORE, formerly a seaport of Hindustan, and a place of great commerce, in the province of North Canara. It is situated at the mouth of a river which communicates with a fine salt-water lake, extending nearly as far to the east as the foot of the mountains. In 1763 it was occupied by Hyder Ali, who established dock-yards for building ships of war, which were found to have been demolished by Tippoo at the time the town was recovered by the treaty of Mangalore. Part of the town has been rebuilt, and there is now a custom-house here. A trade is carried on in rice, betel-nut, pepper, cocoa-nuts, and salt fish. This trade was carried on in boats, which were much harassed by pirates from the Mahratta coast; an evil that has always existed more or less on the shores of India, but has now nearly ceased, owing to the vigilance of the British marine. No manufactures ever existed to any extent, the trade having been destroyed by Tippoo. On the first arrival of the Portuguese in India, Onore was the capital of an independent rajah, who was subdued by them. It was subsequently taken from the Portuguese by the Dutch, who appear to have relinquished it; for, in 1763, when it came into the possession of Hyder Ali, it was considered as the property of the ranee of Bednore. In 1768 it was taken by the British, and was shortly afterwards regained by Hyder. It was taken in 1783 by General Matthews, and was restored to Tippoo at the conclusion of the year. It came under the dominion of the British, with the province of Canara, when Tippoo's empire was overthrown, in 1799. Long. 74. 25. E. Lat. 14. 18. N.

ONOSANDER, a Greek author and Platonic philosopher, who wrote Commentaries on Plato's Politics, which are now lost. But his name is particularly famous for a treatise entitled Λογος Στρατηγικος, a discourse on the duties and qualities of the general of an army, which has been translated into Latin, Italian, Spanish, and French. The time when he lived is not precisely known, but he is imagined to have been contemporary with the Emperor Claudius.

ONRUST, a small island in the Eastern Ocean, on the coast of Java, and Bay of Batavia. It is nearly of a circular form, about 4800 feet in circumference. Here the Dutch had formerly fortifications and extensive works, which were destroyed by a British armament under Sir Edward Pellew, and the island is now desolate. Onrust formerly contained about 3000 inhabitants. It is nine miles north-west from Batavia.

ONTAREE, a town of Hindustan, in the province of Gundwana, belonging to an independent chief in the district of Billounjah. Long. 83. 40. E. Lat. 24. 13. N.

ONTARIO, one of the five great lakes which separate Canada from the United States, and which are the wonder and admiration of the world. It is situated between the parallels of 43. 10. and 44. 11. of north latitude, and the meridians of 76. 25. and 79. 56. of west longitude, being the most easterly of these vast inland seas. It lies nearly east and west, and is of an elliptical shape, being a hundred and seventy-two miles in length by fifty-nine and a quarter in extreme breadth, and having a circumference of about four hundred and sixty-seven miles. The depth of water varies exceedingly, from a few feet up to several hundreds. Towards the middle, attempts have been made to reach the bottom with three hundred fathoms, without striking soundings. If this be correct, the bottom must be very considerably below the level of the Atlantic Ocean; for its surface is only two hundred and thirty-one feet above tide-water at Three Rivers on the St Lawrence, and at Albany on the Hudson. The appearance of the shores of Lake Ontario exhibit great diversity. Towards the north-east part they are low, with numerous marshy places. To the north and north-west they assume a grand and lofty character, but subside again on the south to a very moderate elevation. Bordering the lake, the country is everywhere covered with woods, through the numerous openings of which frequent settlements are seen, imparting a pleasing effect, which is greatly enhanced by the white cliffs of Toronto, and the remarkable high land over Presqu'ile, called the Devil's Nose, on the north. The view on the

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south is well relieved by a back ground of hills, which, after forming the precipice of the cataract, stretch away to the eastward. The crowning object of the prospect in this direction is a conical eminence towering above the chain of heights, called Fifty-Mile Hill, as denoting its distance from the town of Niagara. Along the southern border of the lake is the celebrated ridge road, or alluvial way, extending from Rochester on the Genessee, to Lewiston on the river Niagara, eighty-seven miles. It is composed of common beech sand, and gravel-stones worn smooth, and these are intermixed with small shells. Its general width is from four to eight rods, and it is raised in the middle with a handsome crowning arch, the general surface preserving a very uniform level. It is between a hundred and twenty and a hundred and thirty feet above Lake Ontario, whence it is distant from six to ten miles.

A great number of rivers flow into Lake Ontario. Towards the western part it receives the Niagara, and from this point to the St Lawrence River, which flows from the north-east part of the lake, the line dividing Canada from the United States is in the middle of the lake, so that nearly one half of it is in the state of New York. From this state it receives the Genessee, Oswego, and Black Rivers, besides a number of smaller streams, all of which have a sand bar across the entrance. There are some fine bays and inlets, where vessels of every description may find protection in bad weather. The largest of these are Chaumont, Sodus, Little Sodus, Toronto, and Braddocks, on the United States' side of the lake; and Quinte, Burlington, and many other large ones, on the Canada side. Burlington Bay is both spacious and secure; and the disadvantages of a narrow entrance and shallow water have been obviated by a canal cut across the breach, which has opened an access to the bay for lake vessels, and made it an important and interesting harbour. Hungry Bay is very conspicuous, affording good anchorage and safe shelter amongst the islands to ships of the largest size at all seasons. York and Kingston harbours belonging to Great Britain, and Sacket's harbour to the Americans, possess every natural advantage, and are considered as the best upon the lake. The two latter are strongly fortified, being the arsenals where ships of war, even of the first rate, have been constructed by both powers, and where were fitted out those powerful hostile squadrons which conferred so much consequence on the naval operations in this quarter. Lake Ontario is navigated by sloops, schooners, and steamboats; and the sea is frequently so rough, and swept by such heavy squalls of wind, that steam-boats of common size were at first not considered as fit to traverse its waters with comfort and safety. Of the many islands situated at the eastern end of the lake, Wolf or Grand Island, lying abreast of Kingston, is the most extensive, and, by being placed at the commencement of the Cataraqui River, forms two channels leading into it, which bear the names of the North or Kingston Channel, and the South or Carleton Island Channel. Stony and Grenadier Islands are situated at the eastern end, and there are some at Quinte Bay in Canada. Lake Ontario abounds with excellent fish of various kinds, the most celebrated of which are the Oswego bass, the salmon, trout, and salmon-trout. (R. R. R.)

ONTINIENTE, a large town of Spain, in the province of Valencia, in the department of San Felipe. It is an open town, in the vicinity of the mountains, but stands in a fruitful spot, and is remarkable for the salubrity of its climate. Figs are cultivated near it of good quality, of which about 7000 quintals are annually collected and sent to other districts. The hilly parts in the vicinity produce excellent pears and apples, and near them is raised the best wheat in Spain. The inhabitants amount to 11,700, who, besides cultivation, have some employment in making linen and woollen goods, paper, and copper wares. Being inland, and out of any great road, it is a place very rarely visited by foreign travellers.

ONTONG JAVA, a group of islands in the Pacific Ocean, called by Mendana, Baxos de la Candelaria. They are twenty-two in number, and are now called New Ireland. Long. 156. E. Lat. 6. 15. S.

ONYCOMANCY, or, as some persons write it, ONYMANCY, a kind of divination by means of the nails of the fingers. The word is formed from the Greek ὀνυξ, *a nail*, and μαντεια, *divination*. The ancient practice was to rub the nails of a youth with oil and soot, or wax, and to hold up the nails thus smeared against the sun, when certain figures or characters, showing the thing required, were supposed to appear upon them.

ONYX, a mineral substance usually ranked amongst gems, and which derives its name from the colour resembling that of the nail of the finger.

OOCHASEER, a town of Hindustan, in the province of Cutch, and district of Neyer, about twenty-five miles south-west from Theraud, which belongs to the chief of Morwara. It is surrounded by a thorn hedge instead of fortifications, and has a tank of bad water, with some excellent wells. Its inhabitants are low classes of Hindus.

OOCHINADROOG, a celebrated hill-fort of Hindustan, in the district of Harpoonelly. It is of great natural strength, having an abrupt ascent of very great height, particularly to the north and west, where it is almost perpendicular. It was besieged in 1793, and taken after a siege of three months, by Tippoo, who, with the cruelty of a tyrant, mutilated all the boys and youths in the fortress, most of whom died in consequence. Long. 75. 55. E. Lat. 14. 32. N.

OODEADARGAM, a town of the south of India, in the province of Mysore. It was taken by the British in the year 1800, and now belongs to the rajah of Mysore. It gives name to a celebrated pass in the mountains, and is thirty-one miles south-east of Bangalore.

OOJAIN, a celebrated city and district of Hindustan, in the province of Malwah. The district is situated between the twenty-third and twenty-fourth degrees of north latitude, and between the seventy-fifth and seventy-seventh of east longitude. The soil is in general a black vegetable mould, which is reduced during the rainy season nearly to the consistence of mud; and when it is dried by the sun it cracks in all directions, and the fissures are so wide and deep as to render travelling dangerous. Besides the city of Oojain, this district contains 175 villages. It produces the mango, guava, plantain, melon, and several varieties of the orange and lime trees.

The capital of the above mentioned district is also named Oojain, and is the principal residence of Scindia. It is situated on the Sipperah River, and is one of the most ancient cities of Hindustan, being, according to Major Rennell, the city which was known to the Greeks under the name of Ozene. It is called in the Sanscrit Ujayini, and is stated in authentic records to have been the capital of the rajah Bickermajit, a short time after the commencement of the Christian era. The ancient city was either much larger than the modern town, or it stood almost a mile to the north of it. It was overwhelmed by a violent earthquake at a time when it was the seat of empire, as well as of the arts and of learning. Its site is easily known; for, in digging to the depth of fifteen feet, brick walls, pillars of stone, and other ruins, are discovered. Adjoining these subterranean ruins there is a remarkable cavern, which consists of a long gallery, supported by pillars, with chambers excavated in each, and containing a number of figures carved on the walls, which are of granite. Amongst the ruins ancient coins are frequently found. The modern city of Oojain is of an oblong form, about six miles in circumference, and surrounded by a stone wall with round towers. This space includes some waste ground, but the inhabited part occupies the greater portion, and is much crowded with buildings and population. The houses are built of brick, and covered with tiles. The principal bazaar is a spacious and regular street, paved with stone, and having houses of two stories in height on each side. The whole of the lower story is laid out in shops, the ascent to which is by five or six steps from the street; the upper stories are the dwellings of the owners. The most remarkable buildings in the town are the mosques and temples; Scindia's temple is but a poor building, and is so surrounded by other buildings as to be scarcely observable. The southern quarter of the city is called Jeysingpoor; it contains an observatory, erected by rajah Jyesing of Jyenagur in the early part of last century. An extensive fort and citadel were founded by Mahdajee Scindia, at the distance of about two miles from the city, containing a palace. But these works were stopped at his death, and Gwalior was preferred by the reigning chief as his stronghold and place of refuge. Oojain carries on a considerable trade. From Surat are imported various kinds of European and Chinese goods, which are frequently sold here at a very low price. From Marwar are brought pearls, and quantities of assafœtida, the production of Sinde. Diamonds from Bundelcund also pass through this city on their way to Surat. The city is well supplied with provisions; and fruits, vegetables, and grain abound in all the public markets.

Oojain is a very ancient city; the rajahs who governed it are mentioned by Ferishta as early as A. D. 1008; and it was conquered by the Mahommedans about 1230. The first of the princes who reigned here was named Jyapa Scindia, who was a servant of Bajerow the peishwa, by whom, in reward for his services, the city and district of Oojain were made over to him. He was succeeded by his son Junkojee, who was murdered after the battle of Paniput, and his uncle Ranojee obtained possession of his territories. This chief left two sons, Kedjaree and Mahdajee. The latter being the more aspiring of the two, acquired possession of the sovereignty. He was a brave and active officer, and commanded a division of troops in the memorable battle of Paniput, in which he was severely wounded in the thigh. He rose afterwards to high command, and to extensive dominion. He introduced European discipline amongst his troops, by whose aid he not only rivalled in power the greatest Mahratta chiefs, but conquered a large tract of Hindustan proper, and gained possession of the capital, Delhi, with its fallen monarch, the representative of the Great Mogul. He died in 1794, without issue, leaving the whole of his possessions to his adopted son and grand nephew Dowlut Row Scindia. In the year 1803, Scindia ventured to try his strength with the British, and a war ensued, which was soon terminated by a series of signal victories gained over his imperfectly disciplined troops, by Lord Lake and General Wellesley. He was in consequence soon compelled to sue for peace, which was concluded on the 30th of December 1803, on condition that he should cede all the territory situated between the Ganges and the Jumna, and all his possessions of every description in the country to the northward of those belonging to the rajahs of Jyenagur and Joudpoor, and the ranah of Gohud. He also relinquished to the British government the fort and territory of Broach, and the fort and territory of Ahmednuggur, and all his possessions to the south of the Aguntee Hills, including the fort and district of Gondapoor, and all the other districts between that range of hills and the Godavery. Several forts, towns, and districts, were restored to Scindia. Two of the articles in the treaty, namely, the cession of the strong fortress of Gwalior, and a subsidiary force of 6000 men to be constantly stationed with Scindia, were relinquished by Lord Cornwallis, on his return to India. On the 23d of March 1804, a treaty offensive and defensive was concluded with Scindia by Colonel, afterwards Sir John Malcolm, on the part of the British government, by which Scindia agreed to receive a British subsidiary force of 6000 men, to be stationed near his frontier; and, in the event of a war, engaged to join the Company's forces with 6000 infantry and 10,000 cavalry. He also agreed to submit all the differences he might have with the peishwa to British arbitration. It was agreed that the Chumbul should henceforth be the boundary between the two states. When the war broke out with the Pindarrees, the policy of Scindia excited strong suspicions against him; in consequence of which a new treaty was concluded in 1817, in which it was agreed that he should use his utmost exertions against the Pindarees, and that he should admit British garrisons into the fortresses of Hindia and Aseerghur during the war. The territories possessed by Scindia are still very considerable, and are supposed to yield him nearly a million per annum. For further particulars respecting this prince, see the article HINDUSTAN.

OON, a town of Hindustan, in the province of Gujerat, and district of Werrear, fifteen miles north of Rahdunpoor. The town contains about 2000 tolerably well-built houses, and the palace of the rajah. It is an open town, with one long street, which is a bazaar. The chief of this town is a Hindu of a low tribe, who derives his income of 12,000 rupees a year chiefly from the plunder of his neighbours. Long. 71. 45. E. Lat. 24. 15. N.

OONAE, a small village of Hindustan, in the province of Gujerat, belonging to the Mahrattas. It has in its vicinity a remarkable hot spring, which, like all the other extraordinary phenomena of nature, is held sacred by the Hindus, and a great resort of pilgrims, who ascribe to it the most wonderful qualities.

OONARANG, a small European town and fort of Java, on the south coast, where the Dutch governor Janssens made his last stand when the island was attacked by the British general. It is eleven miles south from Samarang.

OONIARA, a town of Hindustan, in the province of Ajmeer. It is strongly fortified with a wall and round towers; the houses are mostly built of stone, and the palace is neatly constructed with a stone enclosure, surrounded by a ditch. Long. 75. 58. E. Lat. 25. 51. N.

OONOMAFOU, an island in the South Pacific Ocean, about six miles in length, and covered with verdure. It was discovered in 1616 by Schouten and Le Maire. Long. 175. 51. W. Lat. 15. 53. S.

OOREECHA, a populous town of Hindustan, belonging to the rajah of Jyenagur, in the province of Ajmeer.

OOREY, a town of Hindustan, in the province of Agra, fifteen miles west of the river Jumna. Long. 79. 35. E. Lat. 25. 58. N.

OOSCAT, a considerable town of Anatolia, in Asia Minor, situated in a hollow, surrounded on all sides by naked and barren hills. The houses are neatly constructed of brick and wood, painted like those in the other Turkish towns. The palace is a very extensive building of brick and wood, but only two stories high; and a handsome mosque has lately been erected, of hewn stone, in imitation of St Sophia. It is surrounded by a slight wall, built of sun-dried brick and mud. The inhabitants amount to 16,000, of whom the greater number are Turks, and the remainder Greeks, Armenians, and Jews. It is 110 miles east of Angora. Lat. 39. 42. N.

OOSCOTTA, a fortress of the south of India, in the province of Mysore. It was occupied by the Mahrattas in the year 1688, but was taken from them by the nabob of Cuddapah, and retaken by the Mahrattas. In 1761 it was besieged and taken by Hyder Ali; and seven years afterwards it was taken by the British, but recovered by Hyder in 1773. It fell under the power of the British in

1779, and was made over to the new rajah of Mysore along with the province. It is fifteen miles north-east of Bangalore.

OOSSOOR, or OUSOOR, a fortress of Hindustan, in the southern province of Mysore. It was first taken by the British in 1768, and again in 1791. After the death of Tippoo, this town, with the province, was made over to the new rajah of Mysore. It is twenty miles south-south-east from Bangalore. Long. 72. 52. E. Lat. 12. 41. N.

OOSTERHOUT, a market-town of the Netherlands, in the province of North Brabant, and the arrondissement of Breda. It is a considerable place for making pottery ware and tiles, and has large markets three times a year for the sale of linen cloth. It is five miles to the north of Breda, and contains 6950 inhabitants.

OOTAPALLIUM, a town and district of the south of India, in the district of Dindigul. Long. 77. 30. E. Lat. 9. 50. N.

OOTATATOOR, a town of the south of India, in the district of Tanjore. Long. 70. 58. E. Lat. 11. 7. N.

OOTRADOORG, one of the numerous fortresses with which the country of Mysore is covered. It was taken by the British in 1792. Long. 77. 17. E. Lat. 12. 56. N.

OOTRIMALOOR, a town of the south of India, in the province of the Carnatic. Long. 79. 50. E. Lat. 12. 33. N.

OPALIA, in *Antiquity*, feasts celebrated at Rome in honour of the goddess Ops. Varro says they were held on the 19th of December, which was one of the days of the Saturnalia. These two feasts were celebrated in the same month, because Saturn and Ops were husband and wife; but the vows offered to the goddess were made sitting on the ground.

OPARO, an island in the Pacific Ocean, discovered by Captain Vancouver in 1791. It consists of a cluster of high craggy mountains. The natives are estimated at 1500, who appeared to be well fed, and to have open and cheerful countenances. Long. 215. 58. E. Lat. 27. 36. S.

OPERA, a lyrical drama set to music in recitations, airs, duetts, trios, quartetts, choruses, and *finales;* preceded by an instrumental overture, and accompanied by an orchestra; and, when performed, enforced and embellished by action and declamation, and appropriate costumes and scenery. The opera appears to have originated at Florence about the end of the sixteenth century. (See Doni's works, *passim.*) The Italians divide their operas into four kinds; the *sacred opera*, the *serious opera*, the *semi-serious opera*, and the *opera buffa*, or *comic opera*. The French have their *grand' opera*, in which the whole lyrical drama is sung; and the *opera comique*, in which the singing is intermingled with spoken dialogue. The Germans have a greater variety of such distinctions of operas; as the *grand opera*, the *serious opera*, the *tragic opera*, the *heroic opera*, the *romantic opera*, the *allegorical opera*, the *military melodrama*, the *comic opera*, and some others.

Much amusing and interesting matter relative to the rise and progress of the *opera* may be found in Dr Burney's Tours, and History, in the Baron de Grimm's Correspondence, and in various German periodicals conducted by musicians. See also Arteaga, Manfredini, Signorelli, &c. For some technicalities relative to operatic music, see the article MUSIC.

OPHICLEIDE, or KEYED-SERPENT. See MUSIC.

OPHIOLOGY is composed of two Greek words, namely, ὄφις, *a serpent*, and λογος, *a discourse*, and consequently denotes that branch of zoology which treats of serpents. See REPTILIA.

OPHIOMANCY, in *Antiquity*, the art of predicting future events from the motions or habits of serpents. Thus Calchas, on seeing a serpent devour eight sparrows, with their dam, foretold the duration of the siege of Troy; and the seven coils of a serpent which was seen on the tomb of Anchises were interpreted to mean the seven years during which Æneas wandered from place to place before he arrived at Latium.

OPHIR, a country mentioned in Scripture, from whence Solomon received great quantities of gold in ships which he sent out for that purpose. The difficulty, however, is, where to fix its situation. Some have gone in search of it to the West, others to the East Indies, and a few to the eastern coast of Africa. Mr Bruce places it in the kingdom of Sofala, on the coast of Mozambique; and he supports this hypothesis with great learning and ingenuity. It was, on the other hand, strenuously maintained by Dr Doig, a learned contributor to the third edition of this Encyclopædia, that it was situated somewhere on the western coast of Africa, and that the Tarshish of Solomon was the ancient Bætica in Spain. Whether the one hypothesis or the other be the true one, it is not for us to decide. Both are plausible, and both supported by much ingenuity and erudition; but we do not think that the arguments of either writer furnish a complete confutation of those employed by the other.

OPHITES, in *Ecclesiastical History*, Christian heretics, so called both from the veneration they had for the serpent which tempted Eve, and the worship they paid to a real serpent. They pretended that the serpent was Jesus Christ, and that he taught men the knowledge of good and evil. They distinguished between Jesus and Christ. Jesus, they said, was born of the Virgin Mary, but Christ came down from heaven to be united with him; Jesus was crucified, but Christ had left him to return to heaven. They likewise distinguished the God of the Jews, whom they termed *Jaldabaoth*, from the supreme God; ascribing to the former the body, and to the latter the soul of man. They had a live serpent, which they kept in a kind of cage; and at certain times they opened the cage door, and called to the reptile. The animal came out, and mounting upon the table, twined itself about some loaves of bread, which they broke and distributed to the company, all of whom kissed the serpent. And this, by a horrid blasphemy, they called their *Eucharist*.

OPHTHALMOSCOPY, a branch of physiognomy, which deduces the knowledge of a man's temper and character from the appearance of his eyes.

OPIATES, medicines which are administered to procure sleep, whether in the form of electuaries, drops, or pills.

OPINION is that judgment which the mind forms of any proposition, for the truth or falsehood of which there is not sufficient evidence to produce science or absolute belief. That the three angles of a plane triangle are equal to two right angles, is not a matter of opinion, nor can it with propriety be called an object of the mathematician's belief; he does more than believe it, he *knows* it to be true. When two or three men, under no temptation to deceive, declare that they were witnesses of an uncommon though not preternatural event, their testimony is complete evidence, and produces absolute belief in the minds of those to whom it is given; but it does not produce science like rigid demonstration. The fact is not doubted, but those who have it on report do not know it to be true, as they know the truth of propositions intuitively or demonstrably certain. When one or two men relate a story including many circumstances to a third person, and another comes who positively contradicts it either in whole or in part, he to whom these jarring testimonies are given weighs all the circumstances in his own mind, balances the one against the other, and lends an assent, more or less wavering, to that side on which the evidence appears to preponderate. This assent is his opinion respecting the facts of which he has received such different accounts.

OPIUM, in the *Materia Medica*, is an inspissated juice, obtained from the capsule of the white poppy; it is partly of the resinous and partly of the gummy kind, and possesses also a narcotic principle.

OPOCALPASUM, Opocarbasum, or Apocalpasum, a gummy, resinous substance, which has a strong resemblance to liquid myrrh, and which in the time of Galen was mixed with myrrh. According to this writer, it was difficult to distinguish the one from the other except by their effects, the former being of a poisonous nature, and frequently producing lethargy.

OPORTO, or Porto, a city of Portugal, usually considered as the northern capital of that kingdom, and one of the most important commercial places of the peninsula. It is situated in the province Entre Douro and Minho, at the mouth of the latter river. The land near the mouth of the river is generally low, but the city, being situated on an elevation on the northern bank, may be descried at the distance of four or five leagues, by a remarkably black steeple, called Los Clerigos, which rises in the middle of it. On approaching the bar, the town and castle of St John de Foz are seen upon low land, near the mouth of the river, with a lighthouse, lighted every night. On the northern point of the castle of St John de Foz a ledge of rocks extends towards the south-west, some of them above water; and without these, on the opposite side, is a similar ledge. This formation renders the entrance difficult without much previous knowledge, especially as with winds from the south-west and the north-west a heavy sea sets in along the coast. The bar of the Douro is liable to alterations of its position from gales of wind, which makes it the more necessary to take a pilot, a matter not difficult, as there are plenty of fishermen perfectly competent, who are ready to act in that capacity. When vessels have passed the bar they are in a state of security, except at periods when, after a heavy fall of rain, such torrents rush down the Douro as to raise the water from thirty to forty feet in a few hours. These *freshes*, as they are called, have also a great influence in changing the position of the bar. The vessels that are intended for the harbour of Oporto should not, however, draw more than sixteen feet water.

As this city gives name to the whole kingdom of which it forms the second capital, a short sketch of its history may be appropriate. It is first noticed in the itinerary of the Emperor Antoninus, in the year A. D. 160, under the name Cago or Gaia, but was then on the opposite bank of the river, and defended the passage over it against the forces of Viriato. When the Goths, Vandals, Alans, and Suevi had overrun France and Spain, and attained the end of their career, the Alans entered Lusitania, and established their capital in this city, which they adorned and fortified, giving it the name of Castrum Novum, to distinguish it from Cale or Caya, the ancient part, on the opposite bank of the river, called *Castrum Antiquum*. This part of Lusitania was seized upon, about the year 540, by the Arian Goths, under their King Leovogildo, who put to the sword all who refused to embrace his opinions, and, as has been said, amongst others his own son. The Goths maintained their dominion till the invasion of the Moors in 716, when Abdulhassan overran all Galicia, and possessed himself of the whole country up to the river Douro. It fell again into the hands of the Christians, when again the Moorish chieftain Abderrahman, attacked the Catholic King Alfonso I. in 820. A desperate battle was fought at Campanha, in which the Moors were defeated, and many of them driven into the river Tinto; and a part of the city whence the Christians issued to the contest still retains the name of Batalha. Another Moorish chief subsequently conquered the city, and retained his power within it till 1092, when some Gascon knights, under the command of Don Alfonso Fredriquez, finally subdued the Moors; since which it has been retained by the Christians, and followed the fortune of the rest of Portugal.

Oporto is about two miles from the mouth of the river, on the right bank, from which it rises abruptly by an ascent, in some parts attained by a flight of 140 steps. It occupies a valley and several hills, which render some of the streets very steep. Its back or north part rests upon rocky heights, in which are quarries of granite that have yielded the stone with which the city has been built. There are many magnificent and spacious streets, well paved for foot passengers, with some fine churches, convents, and other public buildings; and these are interspersed with numerous gardens, abounding with flowers and beautiful shrubs, which give an air of great beauty to the whole place. The most remarkable edifices, as in most Catholic cities, are those devoted to religious purposes, as churches, convents, and monasteries. The most striking are very magnificently ornamented. The cathedral is a superb building, which was constructed in 1112, by Count Henrique de Porto, and the ascent to the choir is by a fine broad marble staircase. The collegiate church of Cedofeita is the next in celebrity. It is a purely Gothic structure, built in the year 559, and was left untouched by the Moors, having been redeemed from destruction by a noble family of the name of Connigos, who paid a yearly tribute for its preservation. The church of Misericordia, built in the year 1555, belongs to a corporate body, which relieves misery of all kinds, takes care of more than 2000 sick, maintains 900 foundlings, and buries those whose friends cannot afford to do so. The church of the Clerigos, built in 1748, stands at the top of a fine wide street called Calcada de Natividade. It is a superb building, most beautifully ornamented, and has a tower, before noticed, the most lofty in the kingdom, if not in Europe, which may be seen from the sea at the distance of several leagues. The other parochial churches are St Nicolao, said to be the richest, St Victoria, St Ildefonso, Santa Marinha, in Villa Nova; San Pedro; MiragayaTerco e Caridade, which is connected with a good hospital; Nosso Venhor de Bom Fim; St Pedro Gonsalvez, appropriated to the seamen; Bon Jesus de Gaya, and Senora de Lapa. Besides these, there are about eighty chapels, some of them elegantly fitted up, in which the public religious worship is celebrated. There were twelve monasteries, containing no less than 380 monks; but some of them were destroyed during the siege of Oporto by Dom Miguel, and others suffered severely. There were five convents, which contained about 340 nuns of different orders, besides numerous females who resided in them under the tuition of the nuns.

There are few cities in Europe in which the charitable institutions are more numerous than in Oporto. The public hospitals especially are extensive establishments. The principal of them is the Hospital Real, which is built of granite, and has the appearance of a palace, and is remarkable not more for its extent and grandeur than for the great number of patients which are relieved in it; they are attended by the best physicians and surgeons, both English and Portuguese, and are supplied with the best medicines, dispensed not only to the sick in the house, but also to out-door patients at half price. Of a less extent are the foundling hospital, two for unfortunate and poor females, one for beggars, one for poor old women, one for the English, and three upon a small scale distinguished by the names of St Sylva, San Crispin, and San Francesco da Carma.

This city suffered severely during the long siege which commenced in December 1833, and continued till August 1834. It was a period of severe misery to the inhabitants, as well from the constant fire kept up against the

Oporto. town, as from the scarcity of food, fuel, and other necessaries. The army of Dom Miguel had surrounded the city with works, which extended in a circuit of nearly fourteen miles, and from the forts on those lines kept up a cannonade and bombardment. The effect of the former was to make an impression upon the works of Dom Pedro, and that of the latter to destroy whatever was destructible in the houses of the inhabitants, and in the public buildings. The churches were spared by the assailants as far as their position did not interfere with the military operations. Both the public and the private buildings are constructed of massy blocks of stone, and have little combustible matter in their composition. Thus, though the windows, the decorations, and the furniture of many buildings, were much injured or destroyed, and more than sixteen thousand of the civic inhabitants killed, there was but little damage done to the interior appearance of the place; and as far as that was concerned, a very short period witnessed the restoration of the city to its former beauty. Within two years after the termination of the siege the inhabitants had in a great degree returned to those mercantile pursuits and habits which have long distinguished the city.

Oporto, in a national view, is a commercial place of the greatest importance, being the channel by which the most valuable produce of the soil of Portugal is distributed to other countries. That soil is peculiarly favourable to the growth of a strong red wine, highly relished in England, and not much esteemed in any other part of the world. It is produced from a grape originally transported from Burgundy to the banks of the Douro, whence it has spread throughout the province of Tras os Montes and the interior and higher grounds of the province Entre Douro and Minho. From the growers the wines are collected by merchants of Oporto, and preserved in large quantities till they are shipped for the markets of consumption. The best of the wines formed the subject of a monopoly to a privileged company, who possessed the right of pre-emption of a limited number of pipes before the general buyers were allowed to make their contracts. That monopoly has been abolished, a circumstance which has given a new direction to the internal trade; but the sufferings occasioned by the siege are still felt, and this, with the change of system, has made it difficult to prognosticate what may be the future condition of the wine trade in this city. One thing is certain, however, that as long as the taste for port wine continues in Great Britain as it has hitherto done, the trade of Oporto must be of the greatest importance to the kingdom of Portugal.

An Account of the number of Pipes of Wine shipped at Oporto from 1824 to 1833, distinguishing those to the British dominions from those to all other countries.

Years.	Pipes sent to Great Britain.	Pipes sent to all other Countries.	Total.
1824	19,968	6,049	26,117
1825	40,277	170	40,447
1826	18,310	287	18,597
1827	24,207	10,003	34,237
1828	27,932	13,295	41,227
1829	17,832	7,533	25,371
1830	19,333	4,832	24,165
1831	20,171	3,268	23,439
1832	13,575	2,975	16,550
1833	19,432	1,063	20,495
	231,037	49,575	270,645
Average annual export	23,103	4,957	27,064

Of the number of pipes, 49,575, sent to other countries than Great Britain in these ten years, Brazil took 28,261, the other parts of South America 8944, whilst North America, the whole of Europe, India, and Africa, took only 12,370 pipes, of which Hamburg alone received 5573. This statement shows to what an extent the north of Portugal is dependent upon the consumption of Great Britain for the chief product of its soil. A duty is collected from the wine, both on its transport from the interior, and on its exportation to foreign countries. The amount varies with the kind and quality of the wine, and is often subject to considerable fluctuation.

The other exports from Oporto consist of oil, oranges, figs, and various fruits, wool, refined sugar, cream of tartar, shumac, leather, and cork. The imported articles are, corn, rice, and other provisions; sugar and coffee from Brazil; cotton and woollen goods, hardware, tin plates, butter, and cheese, from Great Britain and Ireland; and hemp, flax, deals, and other timber, from Norway or the Baltic. It is said that a large portion of the British cottons and woollens imported at this place are for the purpose of being carried into Spain through Braganza and other frontier towns, by means of the contraband trade.

The manufactures of the city suffered exceedingly by the siege, but are now reviving. The sugar refineries are considerable; gold and silver lace is made, and also some hosiery. Cotton and linen weaving gives some occupation, as do the making of glass and paper. Though the population was reduced by the siege, it is now rapidly recovering its former state, and, by the latest calculation, amounts to about 80,000. Though somewhat cold in the winter, and therefore not so much visited by invalids as Lisbon, Oporto is generally considered as a more healthy city. The latitude, by accurate observation, is 41. 11. 15. N. the longitude 8. 8. 22. west from London.

Oppeln. OPPELN forms one of three provincial governments of Prussia, into which the province of Silesia is divided. It is bounded on the north by the government of Breslau, on the east by the kingdom of Poland and the republic of Cracow, on the south-east by Gallicia, on the south and south-west by Moravia, or rather Austrian Silesia, and on the west by the province of Reichenbach. In extent it is 5230 square miles, comprehending fifty-four cities and towns, and 1492 villages; and it is divided into fifteen circles. The population, according to the census of 1817, amounted to 529,964 individuals, and, according to that of 1826, had increased to 660,756. Of these inhabitants, about nine tenths are Catholics, and the remainder is divided into various sects. It is drained by the river Oder, into which all the streams run. The soil is not very fertile, and its most valuable produce is derived from its extensive forests. The chief industry is applied to spinning and to making wooden ware. The city of Oppeln, the capital of the province, as well as of the circle of the same name, stands on the Oder, and contains 380 houses, with 4500 inhabitants. It is surrounded with walls, and defended by a castle; and it has some trade in linen, in timber, and in ironmongery.

Oppian. OPPIAN, a Greek poet, was born at Corycia or Anazarba, in Cilicia, towards the close of the reign of Marcus Aurelius. His father, Agesilas, held a distinguished rank in the senate of his native place, not so much on account of his birth or his riches, as the credit he obtained for the extent of his knowledge and his love of philosophy, which was the object of all his studies, and the guide of all his actions. To his son he was careful to give an education conformable to his own principles, causing him to be instructed in music, geometry, and particularly the belles-lettres. The young Oppian, however, had scarcely completed his studies, when an unlooked-for reverse damped his ardour, and destroyed all his hopes. Septimius Severus, having mounted the throne, to which he had succeeded in hewing out a way with his sword, arrived at Anazarba, and immediately the senate of the place threw themselves at the feet of the conqueror. Agesilas alone, conceiving himself bound to withhold from an usurper the homage which was due only to the legitimate sovereign, stood aloof upon this occasion; a circumstance which so irritated Severus, that he deprived the philosopher of all his property, and banished him to the island of Melitus, now *Meleda*, situated in the Adriatic. Thither Oppian followed his father, and it was in this compulsory retreat that he conceived and executed his two poems on the Chase and on Fihsing, entitled *Cynegetica* and *Halieutica*. When they were finished, he went to Rome, and presented them to the son of Severus, Antoninus Caracalla, who relished them so much that he permitted the author to demand of him whatever recompense he pleased. Oppian asked only for the release of his father, with permission to the latter to return to his own country; and the emperor, as much touched with the filial affection of the son as he had been delighted with the verses of the poet, not only granted the favour he had asked, but added the gift of a gold statera (about L.1. 4s. of our money) for each one of the verses which he had just heard recited. If, as Suidas pretends, these verses amounted to twenty thousand, never did poet receive so splendid a recompense. But Oppian did not long enjoy his good fortune. Scarcely had he returned to his own country when he sunk into the grave, at the early age of thirty, having fallen the victim of a contagious malady which then desolated the city of Anazarba. His fellow-citizens erected to his memory a magnificent tomb, whereon was engraved an inscription in Greek verse, which Lorenzo Lippi has rendered as follows:

Oppianus vatum decus immortale fuissem,
Invida ni gelidum rapuisset Parca sub Orcum,
Me juvenem placidæ clarum splendore Camænæ,
Si livor longæ violasset tempora vitæ,
Non mihi laude parem quemquam terra alma tulisset.

This is all that we learn of Oppian from the anonymous Greek historian of his life, whom all the succeeding biographers have faithfully copied. We must, however, except the learned editor of his works, Schneider, who, being struck with the disparity of style which he remarked in the poems on the Chase and on Fishing, conceived that two works, which, according to him, were so different in merit, could not possibly have been the productions of the same author. Accordingly, he supposed that there were two Oppians, the first of whom, a native of Cilicia, and author of the *Halieutica*, preceded the second by several years. In the opinion of Schneider, it is to the latter that we are indebted for the *Cynegetica*, in which the author has, according to him, attempted to reproduce, but with great inferiority of talent, the manner and some of the imagery of the first Oppian. M. Belin de Ballu has, however, completely refuted this bold hypothesis, in the preface to his Greek edition of the *Cynegetica*, published at Strasburg in 1786. How, indeed, could it be reconciled with the unanimous concert of praise which critics, ancient and modern, have lavished upon this poet? John Tzetzes calls him a model of grace; J. C. Scaliger compares him to Virgil, in point of numbers, harmony, and elegance of style; Gaspar Barth, Conrad Gesner, and many others, never cite him except to couple his name with laudatory epithets. It is not easy, however, to reconcile so much praise bestowed on the one hand, and so little regard evinced for the works of Oppian on the other; nor can we help feeling some astonishment, when we consider that, from the date of the *editio princeps*, printed at Florence in 1515, two centuries elapsed before the appearance of the first really critical edition, published by Schneider in the year 1777. During this long period, it is true, there appeared several editions at considerable intervals, particularly that of Aldus, Venice, 1517, which Schneider considers as very defective, and regards as the source of all the faults which, till his time, had disfigured the text; that of Vascosan, Paris, 1549; and that of Rittershusius, Leyden, 1597. No edition appeared in the seventeenth, nor any in the eighteenth century, until the year 1777, when that of Schneider was published at Strasburg, containing the Greek text, accompanied with a Latin translation, and followed by the paraphrase in prose which the sophist Eutechnius had made of the *Ixeutica*, another poem attributed to Oppian, but which, unfortunately, has not come down to our time. This was followed by the edition of Belin de Ballu, published at Strasburg in 1786, but containing only the *Cynegetica*, of which the editor published, at the same place, the following year, a good French translation, enriched with critical notes, and a curious extract from El Doinaï's history of animals, translated from the Arabic by Baron Silvestre de Sacy, who, however, for some reason, withheld his name. Prior to this there were two French translations, one by Florent Chrestien, preceptor to Henry IV. when prince of Bearn; and another by Fermat, a counsellor of Toulouse, who, in 1690, published a prose version of the books on Hunting by Arrian and Oppian. The poem on Fishing was translated into English heroic verse by Jones and others, belonging to St John's College, Oxford, and printed there in 1722, 8vo, with a life of the author prefixed. The Latin translation of Lorenzo Lippi, printed in 1478, preceded by thirty-seven years the *editio princeps* of the Greek text. (A.)

OPPIDO, a city of Italy, in the province of Calabria Ulteriore I., in the kingdom of Naples. It stands on a hill between the rivers Modena and Trecosio, is the see of a bishop, and contains a cathedral and three other churches, with 6000 inhabitants. It suffered most severely in the earthquake of 1783, when nearly one half of the population was destroyed.

OPPILATION, in *Medicine*, the act of obstructing or stopping up the passage of the body, by redundant or peccant humours. This word is used chiefly to denote obstructions in the lower intestines.

OPOUN, the most easterly of the Navigators' Islands, in the South Pacific Ocean. Long. 169. 7. W. Lat. 14. 7. S.

OPTATIVE Mood, in *Grammar*, that which serves to express a desire or wish for something. In most languages, except the Greek, the optative is expressed by prefixing to the subjunctive a conjunction, which, with the verb, expresses the thing wished for, leaving the mind to supply the verb indicative of desire; as *utinam saperes*, "that you were wise," or, in other words, "*I wish* that you were wise."

OPTIC Angle, the angle which the optic axes of both eyes make with one another, as they tend to meet at some distance before the eyes.

Optic *Axis*, the axis of the eye, or a line going through the middle of the pupil and the centre of the eye.

OPTICS.

History.

OPTICS, from the Greek word ὀπτομαι, which signifies to *see*, is the name given to that branch of natural philosophy which treats of the nature and properties of light; of the changes which it suffers either in its qualities or in its course when transmitted through bodies, when reflected from their surfaces, or when passing near them; of the structure of the eye, and the laws of vision; and of the construction of those instruments in which light is the chief agent.

HISTORY.

The early history of optics, like that of all the sciences cultivated in ancient times, is involved in much obscurity. After the art of glass-making was discovered, lenses and spheres of glass seem to have been used as burning-glasses. In Aristophanes's comedy of *The Clouds* a burning sphere is distinctly described. Pliny speaks of globes of glass which produced combustion when held to the sun. Lactantius informs us that a globe of glass full of water could, when exposed to the sun, kindle a fire even in the coldest weather. And it appears that globes of glass were used by the Vestal Virgins to kindle the sacred fire, and by surgeons to burn the flesh of sick persons that required to be cauterised.

Aristophanes. B.C. 424. Lactantius. A.D. 303.

Among the earliest speculators on vision were Pythagoras and Plato; the former held that bodies became visible by means of particles projected from their surfaces and entering the eye, while the latter, in order to give the eye some share in the matter, supposed that something emitted from the eye met with something emitted from the object, and was again returned into the organ of vision. The followers of Plato, however, though they had deteriorated rather than improved the conclusion of Pythagoras, were acquainted with two important facts in the science. They taught that light moved in straight lines, and that when it was reflected regularly from the surfaces of polished bodies the angle of incidence was equal to the angle of reflexion.

Pythagoras. Plato.

The earliest writer on optics was Euclid, the celebrated geometer, whose treatise on the subject is still extant.[1] It consists of two books on optics and catoptrics, and proceeds on the Platonic theory, that the visual rays pass from the eye to the object, forming a cone whose apex is in the eye and whose base is the object. He shews that the angles of incidence and reflexion are equal, and that the incident and reflected rays lie in a plane at right angles to the reflecting surface; and he discusses the apparent magnitude and form of objects, and the apparent place of the images formed by reflexion from plane, convex, and concave mirrors. The book on optics contains sixty-one, and that on catoptrics thirty-one theorems.[2]

Euclid. B.C. 300.

As a naturalist Aristotle made some valuable optical observations. He described, with tolerable correctness, the phenomena of rainbows, halos, and parhelia. He considered the rainbow as produced by the reflexion of the sun's rays from the drops of rain which gave an imperfect image of the sun; and he ascribes the light which appears in the sun's absence to the reflective power of the atmosphere.

Aristotle. B.C. 410.

The speculations of Seneca and Cleomedes derive any interest they may possess from their absurdity. Seneca noticed the magnifying power of a bottle of glass in enlarging small letters, and he observed that an angular piece of glass produced all the colours of the rainbow. Cleomedes, in his cyclical theory of motion, has given an elaborate explanation of the manner in which rays proceeding from the eye render the objects which they meet visible, but it is too stupid to demand the slightest attention.

History. Seneca. A.D. Cleomedes. A.D.

The science of optics may be justly considered as owing its origin to the celebrated Claudius Ptolemy, the astronomer of Alexandria, who flourished at the end of the first century. His work entitled *Ptolemæi Opticorum Sermones quinque ex Arabico-Latine versi*, was known in the time of Roger Bacon to have treated on astronomical refractions, but it had escaped the notice of philosophers, and its valuable contents were unknown until 1816, when Delambre published an analysis of it from the manuscript in the Royal Library at Paris. Montucla had, long before the discovery of the French manuscript, mentioned that a manuscript copy of Ptolemy's Optics was in the catalogue of the Bodleian Library of Oxford. This interesting manuscript, which Professor Rigaud was so kind as to examine at our request, belongs to the Savilian Library, and had been the property of Sir Henry Savile himself. As in the Parisian manuscript the first book is wanting, but it has no blank spaces like the Parisian one, and it is accompanied with a preface by the translator, containing an abstract of the work, and stating that the fifth book is imperfect. The translator mentions that the second book had been previously translated from Arabic into Latin by Amiratus Eugenius, a Sicilian, from the latest of two copies of which, the new translation was made. The following abstract of this interesting work is taken from Delambre's Analysis, and from the translator's abstract as communicated to us by Professor Rigaud.

Ptolemy. Born 70.

"The Optics of Ptolemy consists of five books. The *first* book is wanting, but from the recapitulation of it at the beginning of the second, it appears to have contained a dissertation on the relations between light and vision, founded on the idea that the visual rays issue from the eye. In the *second* book he shews that we see better with two eyes than with one, and that the object is not seen in the same place with one eye as with two. Vision, he says, is single, if the two axes of the pyramids of the visual rays are directed in the same manner on the object, but becomes double if the axes are not directed in a similar manner, and if the distance is a little less than the distance between the eyes. He next proceeds to find, geometrically, the circumstances which produce single or double images. He ascribes imperfection of sight in old men to a want of the visual virtue, which, like the other faculties, decays with the approach of age; and he states that those who have *concave* eyes see at a less distance than those who have not such eyes. Rapidity of motion, he asserts, confounds the colours on a wheel. If the colour is in the direction of a radius the wheel will appear entirely of this colour, and if different colours are at different distances from the centre, these will

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[1] Euclidis *Optica et Catoptrica* nunquam antehac Græce edita. Eadem Latine reddita per Joannem Penam, Regium Mathematicum. His præposita est ejusdem Joannis Penæ de usu optices prefatio, ad illustrissimum principem Carolum Lotharingum Cardinalem. Parisiis, 1557.

[2] Dr. Smith is of opinion that this treatise was not written by Euclid the geometer; an opinion which he rests on the number of blunders which the author has committed. Smith's *Optics*, vol. ii. Rem. p. 16. § 93.

appear on the wheel as so many concentric circles differently coloured. When, after looking long at a coloured object, we direct the eye to another, we attribute to it the colour of the first.

"In the *third* book, which treats of reflexion from plane and concave mirrors, he shews, that in a plane mirror the object is seen in the perpendicular, drawn from the object to the plane of the mirror and continued behind it. He mentions that objects appear smaller towards the zenith and larger towards the horizon, because in the former case we see them in a position to which we are less accustomed.

"In concave mirrors the objects appear concave, and in convex ones they appear convex, and the image is seen at the point of intersection of the reflected ray, and the line drawn from the object to the centre of the sphere.

"The *fourth* book treats of concave and compound mirrors, and of the effects of two or more mirrors. In these mirrors an object may be reflected and rendered visible by all the parts of the mirror, or by three, or two, or even one point. The image may be either on the surface of the mirror, or before the surface, or behind the eye, or behind the mirror. When the image is behind the mirror, the distance of the object from the mirror is less than that of the image. When the image is between the eye and the mirror the distance of the object from the eye will be sometimes greater than the distance of the image from the mirror, and sometimes it will be equal to it, and sometimes less. When the object is between the mirror and the eye it will be seen in a part different from that where it really is; and if we give it a motion in one direction it will appear to move in the opposite direction.

"The *fifth* book is the most curious and valuable of the whole work. Ptolemy begins by explaining the experiment with the piece of money, which, when concealed behind the side of a vessel, becomes visible by filling it with water. The refraction of the visual ray in penetrating the water makes us see the piece of money out of its place, and in the prolongation of the primitive direction of the ray emitted from the eye. In order to measure this refraction at different angles, Ptolemy employs a circle divided into 360°, the inferior half of which is plunged in the water, so that the refracting surface covers one of the diameters of the circle. The centre of the circle is marked by a small coloured body, and a second similar body is fitted to one of the quadrants out of the water, and at a given distance from the vertical diameter; a third coloured body slides on the lower part, which is immersed in the water. This last body is then pushed with a rod till the eye placed on the body in the air sees all the three in a straight line. The two distances of the second and third body from the vertical diameter are thus measured on the graduated circle.

"In this manner Ptolemy obtained the results in the following table, which contains the angles of refraction from *air* to *water* from 10° up to 80° of incidence.

Angles of incidence.	Angles of refraction.	Ratio of the sines of the angles of incidence and refraction.
0°	0° 0′	
10	8 0	1 to 0·80143
20	15 30	1 — 0·78136
30	22 30	1 — 0·76537
40	28 0	1 — 0·73037
50	35 0	1 — 0·74875
60	40 30	1 — 0·76992
70	45 0[1]	1 — 0·75249
80	50 0	1 — 0·77786

The mean of these ratios is 0·76736, differing little from the correct one, viz. 0·7486; and it is interesting to remark, that at an incidence of 40° and 50, where the angle of refraction can be measured most accurately, the results of Ptolemy approach very near to the truth.

"In order to measure the angles of refraction from air into glass, Ptolemy adopted the ingenious idea of procuring a semi-cylinder of pure glass, and adjusting the diameter of it so as to coincide with the horizontal diameter of the graduated circle already described. By performing the very same experiments which he made with water, he found that there was no refraction at a perpendicular incidence; but that for every other position the angle in the air was always greater than the angle in the glass, and the refraction greater than in water. When the three bodies were placed in appearance in the same straight line they always remained there, whether the eye was placed above the glass or below it. The following are the refractions from *air* to *glass* which he obtained in this manner:—

Angles of incidence.	Angles of refraction.	Ratio of the sines of the angles of incidence and refraction.
0°	0° 0′	
10	7 0	0·70179
20	13 30	0·68255
30	20 30[2]	0·70041
40	25 0	0·65748
50	30 0	0·65270
60	34 30	0·65403
70	38 30	0·66247
80	42 0	0·67946

The mean of these ratios is 0·67386, whereas the true ratio is 0·64516; but at the angles of incidence of 40°, 50°, and 60°, the ratio is very near the true one.

When the semi-cylinder of glass was placed on the surface of water, Ptolemy observed that the refractions from water into glass were less than any he had observed, because the difference of density between *water* and *glass* was less than between *water* and *air*. The following were the results which he obtained:—

Angles of incidence.	Angles of refraction.	Ratio of the sines of the angles of incidence and refraction.
0°	0° 0′	
10	9 30	0·95044
20	18 30	0·92774
30	27 0	0·90778
40	35 0	0·89233
50	42 30	0·88192
60	49 30	0·87804
70	56 0	0·88422
80	62 0	0·89657

The mean of these ratios is 0·90, the true ratio being 0·8760, the index of refraction for water being 1.336, and that of glass 1·525; but at the angles of incidence of 50°, 60°, and 70°, the ratio is very near the true one.

Ptolemy now discusses the important subject of astronomical refraction, which he ascribes to the difference of density between ether and air. If the visual ray, he remarks, is stopped by an impenetrable body, it could not shew us a body which is hid behind the first; and if the second becomes visible, it can only be on account of the flexion of the visual ray. This flexion takes place at its passage into a medium of different density; and the possibility of this flexion, he asserts, may be proved by the following phenomena. By observations on the stars, it was found that the parallels drawn through the apparent place of those which rise or set, are those nearer the north pole than the paral-

[1] This is 45° 30′ in the Oxford manuscript.
[2] In the Oxford MS. this is 18° 30′. Professor Rigaud supposes the real number to have been 19° 30′.

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lels which pass through their apparent place when they are in the meridian; and the nearer the stars are to the horizon, the greater is the approach of their parallels to the pole. By observing a circumpolar star, Ptolemy found that it was nearer the pole in its lower passage across the meridian; but when it was near the zenith, its parallel became greater in appearance, whereas in the first case it became smaller. Hence it follows that refraction raises the stars towards the zenith. In order to explain the manner in which refractions operate, Ptolemy makes use of the same figure upon which Cassini has since founded his theory. He employs almost the same reasoning in order to determine the quantity of the refraction. He remarks, that the more a star is elevated, the less will be the difference between its true and its apparent place, and that this difference will be nothing in the zenith, because a perpendicular ray experiences no flexion. He demonstrates by a figure, that in every case the refraction carries the star towards the zenith; and he states that the height of the atmosphere is unknown, but that it must begin below the sphere of the moon. From this general account of the fifth book of the Optics of Ptolemy, it will be seen that he gives a theory of astronomical refractions much more complete than that of any astronomer before the time of Cassini.

These important results, which, without any other assistance, would have enabled the optician to trace the progress of the rays of light through lenses of all forms, were not applied as they might have been, to extend the boundaries of the science. Banished from Europe, optics, along with the other sciences, found shelter in Arabia; and after a period of a thousand years, it was destined to receive fresh accessions in that favoured country.

Alhazen. A.D. 1100.

Alhazen, who flourished about the end of the eleventh century, was the individual who gave this fresh impulse to optical science.[1] He establishes the opinion of Pythagoras, that vision is performed by rays which proceed from the object to the eye; and he states that vision is not completed till the ideas of external objects are conveyed by the optic nerves to the brain; and after a description of the eye and its parts, he assigns to each of them the function which it performs in vision. He maintains that we see objects singly with two eyes, because we must perceive only one image when it is formed on corresponding parts of the retina. The instrument employed by Alhazen for measuring the angle of refraction, is more complex than that used by Ptolemy, and his knowledge of the refraction of the atmosphere and of fluids, is obviously inferior to that of the Alexandrian philosopher. Alhazen ascribes to refraction the twinkling of the stars, and the contraction of the diameters and distances of the heavenly bodies; and it follows from his method of reasoning, that refraction elevated the stars towards the pole and not towards the zenith, as had been sagaciously ascertained by Ptolemy. Alhazen has described *seven* species of mirrors, and he was the first person who determined the focus of rays after reflexion, when the place of the object is known. He has treated largely of optical illusions, whether produced in direct or in refracted and reflected vision; and he ascribes the size of the horizontal moon to the apparent form of the concavity of the sky, which is imagined to be more remote in the horizon than any where else. Alhazen likewise observed that objects were magnified when held close to the plane wall of the larger segments of a glass sphere; and he has given rules, which are far from being correct, for determining the apparent size of objects when seen through such spheres.

Vitello. A.D. 1270.

The next cultivator of optics was Vitello, whose work was first published at Nuremberg in 1535.[2] He made a series of experiments on the angles of refraction of water and glass, which apparently exceeded those of Ptolemy in correctness, the mean ratio of the sines being nearer the truth, and the ratio for each angle of incidence coinciding more accurately with the mean ratio. The following are the results he obtained with *water*:—

Angles of incidence.	Angles of refraction.	Ratio of the sines.
0°	0° 0′	
10	7 45	0·77658
20	15 30	0·78135
30	22 30	0·76537
40	29 0	0·75423
50	35 0	0·74875
60	40 50	0·74992
70	45 30	0·75904
80	50 6	0·77787

The mean of these ratios is 0·76414, whereas that obtained by Ptolemy was 0·76736, and the true ratio (the index of refraction being 1·3358), 0·7486. The results for 30° and 60° are exactly the same as Ptolemy's.

The following were the measures obtained by Vitello for *glass*:—

Angles of incidence.	Angles of refraction.	Ratio of the sines.
0°	0° 0′	
10	7 0	0·70179
20	13 30	0·68255
30	19 30	0·66761
40	25 0	0·65748
50	30 0	0·65270
60	34 30	0·65403
70	38 30	0·66247
80	42 0	0·67946

The mean of these ratios is 0·66976, whereas that obtained by Ptolemy is 0·68736, and the true ratio 0·64516.

In comparing this last table with the similar one given by Ptolemy, we cannot fail to be struck with their entire similarity, with the single exception of the angle of refraction at 30° of incidence, which Vitello makes 19° 30′, and Ptolemy, in the Paris copy, 20° 30′. Now, in the Oxford manuscript, the numbers are 18° 30′; and Professor Rigaud conjectures that the real number has been 19° 30′, the same as Vitello's. Hence we cannot on any just grounds regard the measures of refraction given by the Polish philosopher as any thing else than those of Ptolemy, from whom he must have borrowed them.

By comparing the two tables for water, we are inclined to make the same unfavourable supposition. The refraction for 20°, 30°, and 50° of incidence are exactly the same in both; and Vitello's measure for 70°, viz. 45° 30′, is the same as Ptolemy's in the Oxford manuscript.

But this opinion is converted into certainty when we examine Vitello's table of the refractions from water into glass, in which all the measures are *identically* the same with those of Ptolemy.

In the course of his experiments, Vitello was led to observe that whenever light was reflected or refracted by transparent bodies, a certain portion of it was lost, but he does not estimate the quantity, contenting himself with the observation that bodies always appear less luminous when seen by refracted and reflected light. In treating of the cause of the rainbow, he shews that refraction is as neces-

[1] Montucla has very incorrectly charged Alhazen with borrowing the greater part of his optics from Ptolemy. Delambre has refuted this opinion, and rendered it probable that the Arabian philosopher never saw the work of Ptolemy. What assistance he obtained from his predecessors who flourished after Ptolemy cannot now be ascertained. See *Connaissance des Tems* for 1816.

[2] This work has been very erroneously regarded as little more than a translation of Alhazen's treatise.

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sary to its production as reflexion, but he of course does not ascribe the colours to refraction, regarding it merely as a means of giving strength or condensation to the solar rays. He imitated the colours of the rainbow, (which, like Seneca, he considers as having their origin in a mixture of the sun's rays with the blackness of the cloud), by placing a white piece of paper beneath a circular vessel of glass containing water; but he says that they are not the same colours with those of the rainbow, because they are not in the same number, and do not reach the eye after reflexion. He shews that in those countries where the meridian altitude of the sun exceeds the semi-diameter of the rainbow, a rainbow cannot be seen at noon. His observations on the foci of glass spheres, on the twinkling of the stars, and on other optical phenomena, are of no value, and rather tend to confirm the severe censures which Baptista Porta has pronounced upon his scientific character.

Passing over archbishop Peckham's treatise on optics, entitled *Perspectiva Communis*, as containing nothing either new or important, we come to consider the claims of Roger Bacon to the invention of the microscope and the telescope. In his *Opus Majus*, which embraces his *Perspectiva* and *Specula Mathematica*, he has given an account of his speculations and inventions in optics. Dr. Plott, Dr. Friend, Dr. Henry, Wood, Muschenbroek, Jebb, and William and Samuel Molyneux have agreed in regarding Bacon as the inventor of the telescope, while Dr. Smith of Cambridge is of opinion that he wrote only *hypothetically*, and had never made any experiments with real lenses. As this is not the place to discuss this subject in a critical manner,[1] we shall content ourselves with giving a single extract respecting the telescope and microscope.

Roger Bacon. Born 1214.

"Greater things than these may be performed by refracted vision. For it is easy to understand by the causes above mentioned, that the greatest things may appear exceeding small, and on the contrary; also that the most remote objects may appear just at hand, and on the contrary. For we can give such figures to transparent bodies, and dispose them in such order with respect to the eye and the objects, that the rays shall be refracted and bent towards any place we please; so that we shall see the object near at hand, or at a distance, under any angle we please. And thus from an incredible distance we may read the smallest letters, and may number the smallest particles of dust and sand, by reason of the greatness of the angle under which we may see them; and on the contrary, we may not be able to see the greatest bodies just by us, by reason of the smallness of the angles under which they may appear; for distance does not affect this kind of vision, excepting by accident, but the quantity of the angle. And thus a boy may appear to be a giant, and a man as big as a mountain, forasmuch as we may see the man under as great an angle as the mountain, and as near as we please; and thus a small army may appear a very great one, and, though very far off, yet very near us, and on the contrary. Thus also the sun, moon, and stars may be made to descend hither in appearance, and to appear over the heads of our enemies; and many things of the like sort, which would astonish unskilful persons."

Whether these remarks were the result of speculation or of actual experiment, it is not easy at this distance of time to determine; but in opposition to the opinion of Dr. Smith, we may adduce a passage from Recorde's *Pathway to Knowledge*, printed in 1551, in which he distinctly speaks of a glasse used by friar Bacon. "Great talke there is of a glasse he made at Oxford, in which men might see things that weare don, and that was iudged to be don by power of euill spirites. But *I know* the reason of it to be good and natural, and to be arright by geometry (with perspective as a part of it), and to stand as well with reason as to see your face in a common glass."

Invention of Spectacles.

On the authority of various passages in the writings of friar Bacon, Mr. Molyneux is of opinion that he was acquainted with the use of spectacles, and when Bacon says that "this instrument (a plano-convex glass, or large segment of a sphere), is useful to old men, and to those that have weak eyes; for they may see the smallest letters sufficiently magnified," we are at least entitled to conclude that the particular way of assisting decayed sight which he describes was known to him, though he may not have used his segment of a glass sphere in looking at objects separated by an interval from its plane side. But whether spectacles were in use or not in Bacon's time, it is quite certain that they were known and used about the time of his death, which happened in 1292. Alexander de Spina, a native of Pisa, who died in that city in 1313, having seen a pair of spectacles made by some other person, who was unwilling to communicate the secret of their construction, got a pair made for himself, and found them so useful, that he cheerfully made the invention public. M. Spoon,[2] to whom we are indebted for this fact, fixes the date of the invention between 1280 and 1311. Signior Redi, from whom Spoon quotes the preceding fact, states that he possesses a manuscript written in 1299, *Di Governo della Familia de Scandro di Pissozzo*, in which the author says, "I find myself so pressed by age, that I can neither read nor write without those glasses they call spectacles, lately invented, to the great advantage of poor old men, when their sight grows weak." It is stated also in the Italian Dictionary *Della Crusca*, under the head of *Occhiale* or *Spectacles*, that friar Jordan de Rivalto, who died at Pisa in 1311, tells his audience, in one of his sermons, which were published in 1305, "that it is not twenty years since the art of making spectacles was found out, and is indeed one of the best and most necessary inventions in the world." Bernard Gordon, too, a celebrated physician of Montpellier, in his *Lilium Medicinæ*, published about 1305, recommends an eye salve as capable of making the patient read the smallest letters without spectacles; and Muschenbroek informs us that it is inscribed on the tomb of Salvinus Armatus, a Florentine nobleman, who died in 1317, that he was the inventor of spectacles.

Leonard Digges. Died 1574.

Before we quit the period of Friar Bacon we must notice a claim to the invention of the telescope which has been made in favour of Leonard Digges, an Englishman, because this claim, whatever be its amount, supports undeniably the prior claim of Bacon. The claim of Digges is founded on passages in his *Pantometria* and *Stratiotikos*. The first of these works appeared at London in 1571, and a second edition of it, edited by his son Thomas Digges, Esq., was published in 1591. The *Stratiotikos* was published in 1579 and also in 1590. In the preface to the second edition of the *Pantometria*, Thomas Digges remarks: "My father, by his continuell painfull practices, assisted by demonstrations mathematical, was able, and sundrie times hath, by proportionall glasses, duely situate in conuenient angles, not onely discouered things farre off, read letters, numbred peeces of money, with the verye coyne and superscription thereof, cast by some of his freends of purpose upon downes in the open fields, but also seuen miles off declared what hath beene doone in priuate places."

In the twenty-first chapter of the first book, Leonard Digges himself says, "But marvellous are the conclusions that may be performed by glasses (mirrors) concave and convex, of circular and parabolic forms, using for multiplications of

[1] We must refer our readers to a series of able anonymous letters upon this subject, published in the *Philosophical Magazine*, vols. 18, 19.

[2] *Recherches Curieuses d'Antiquité*, dissert. 16.

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beams, sometimes the aid of glasses transposed, which, by practice, should unite or dissipate the images or figures presented by the reflection of others. By these kind of glasses, or rather frames of them placed in due angles, yee may not only set out the proportion of an whole region, yea, represent before your eye the lively image of every house, village, &c., and that in as little or great space or plan as ye will presente; but also augment or dilate any parcell thereof, so that, whereas, at the first appearance a whole toun shall present itself so small and compact together that ye shall not discover any difference of streets, yee may, by application of glasses in due proportion, cause any peculiar house or room thereof dilate and shew itself in as ample form as the whole touns at first appeared, so that yee shall discern any trifle, or read any letter lying there open, especially if the sun beams may come into it, as plainly as if you were corporeally pressent, although it be distant from you as far as eye can discrie. But of these conclusions I mind not here more to introduce, having at large, in a volume by itself, opened the miraculous effects of perspective glasses."

Now it is a curious fact that Thomas Digges expressly says that his father's knowledge of optics "partly grew by the aid he had by one old written book of Bakon's Experiments, that by strange aduenture, or rather destinie, came to his hands."

In support of the opinion that the telescope was known in England more than forty years before 1609 or 1610, when it was supposed to have been invented in Holland, we may quote a passage or two from the celebrated John Dee's mathematical preface to Euclid, written at Matloke on the 9th of February 1570, the year in which it was published. "Is it not," says he, "greatly against the sovereignty of man's nature to be so overshot and abused with things before his eyes? things far off to seem neer, and neer to seem far off; small things to seem great and great to seem small; one man to seem an army, or a man to be constantly afraid of his own shadow; yea, so much to fear, that if you, being alone, near a certain glasse,[1] and profer with dagger or sword to foyne at the glasse, you shall suddenly be moved to give back by reason of an image appearing in the air between you and the glass, with like hand, sword, or dagger, and with like quickness foyning at your eye, likewise as you do at the glasse." He then mentions that such a glass was in the possession of a gentleman famous and honourable for his good service done to his country. Dee likewise speaks of having seen once or twice in company with Orontius at St. Denis in 1551; "The lively image of another man in the air aloft, walking to and fro or standing still;" but the most remarkable passage is that in which he speaks of the means of ascertaining the numbers of an enemy's army; "The herald, pursuivant, sergiant royall, captain, or whosoever is careful to come near the truth herein; besides the judgment of his expert eye, his skill of ordering tacticaly, the help of his geometrical instrument; ring or staffe astronomical, commodiously framed for carriage and use. *He may wonderfully help himself by perspective glasses*, in which I trust our posterity will prove more skilful and expert, and to greater purposes than in these days can be credited to be possible."

When polite learning began to revive in Europe some of the more abstract sciences began to be cultivated with success. Maurolycus, a teacher of mathematics at Messina, was particularly distinguished by his optical researches, of which he published an account in his *Theoremata de Lumine et Umbra* and his *Diaphanorum Partes, seu libri tres.* In the first of these works, which was completed in 1525, but not published till 1575, Maurolycus treats of the measure of light, or the illumination of bodies, and he particularly explained the curious phenomenon which had been observed since the time of Aristotle, that when the sun shone through an aperture of any form, the figure of the aperture always appeared round, except when the sun was eclipsed, when it had the appearance of a crescent. He shews that each point of the aperture is the apex of two opposite cones of rays, one of which has the sun for its base, while the other, when cut by a plane at right angles to its axis, will produce a luminous circle, whose diameter will be proportional to the distance of the plane from the aperture. "Consequently if these images be taken at a considerable distance from the aperture, and therefore be pretty large when the aperture itself is small; since the whole image consists of a number of images, all of which are circular, the image of the sun formed by the aperture, of whatever form it be, must be circular also; and it will approach the nearer to a perfect circle the smaller is the aperture and the more distant the image." It may be easily shewn, indeed, that a small aperture acts like a lens in forming an inverted picture of all external objects in a dark chamber, and that then pictures become more distinct in their outline as the aperture becomes smaller. Hence the sun's image is round, or a crescent, according as the sun's disc is entire or eclipsed. In studying the phenomena of vision Maurolycus was very successful. He shews that the crystalline humour is a lens which collects the rays which enter the eye and converges them to foci on the retina; but he does not seem to have found that these foci depict an exact image or picture of the object upon the retina. Limited, however, as this discovery was, it enabled him to ascertain the cause of *long* and *short-sightedness*, the pencils in the former case coming to a focus before they entered the retina, and in the latter at points beyond the retina. Hence, as in both these cases, vision is indistinct either from a too early or a too late convergence of the rays, he concluded that concave glasses of suitable focus would relieve the short-sighted person, and convex glasses the long-sighted person.

Maurolycus. A.D. 1525.

The subject of the rainbow also occupied Maurolycus's attention. He found the diameter of the outer bow 42°, and that of the inner from 53° to 56°; but according to the theory which he adopted, namely that part of the sun's rays were partly reflected from the exterior of the drop, while the rest entered the drop and circulated within it by reflexion along the sides of an octagon; the diameters of the bow should have been 45° and 56°. Maurolycus supposed the colours of the rainbow to be *four*, namely, *orange, (crocus), green, blue*, and *purple*. Taking his *crocus* to be red, his enumeration in leaving out the yellow, as Dr. Wollaston did more recently, shew much accuracy of observation.[2] Maurolycus attempted to discover the law of refraction but without success. He supposed that the angle of refraction was always five-eighths of the angle of incidence, which is a tolerably correct estimate in the case of glass, but quite erroneous for bodies of low and high refractive powers.

Maurolycus may be considered as the first discoverer of the aberration of figure, in so far as he observed that the rays which were incident at a distance from the axis of a transparent sphere, had their focus nearer the sphere than those which were incident nearer the axis. This happy observation was the result of his having noticed the caustic curves formed by such spheres, which he justly described as arising from the continued intersections of the refracted rays.

While the Sicilian philosopher was making new and important discoveries a celebrated Neapolitan, Joannes Baptista Porta, was endeavouring to promote the interests of science, as an ardent collector of its stores, as well as an original inquirer into its mysteries. He established an Academy of Sciences

[1] By a glass, he means "any thing from which a beam reboundeth."

[2] The yellow which is in the sun's direct rays is observed when the sun's rays are reflected from the sky or from clouds.

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which held its sittings in his own house, and which numbered among its members all the *virtuosi* in Naples. Each member was bound to contribute to the common stock something not commonly known, and in this way he obtained the materials for his *Magia Naturalis* which appeared in the year 1560,[1] when he was only about fifteen years of age. This work was speedily translated into French, Hebrew, Spanish, and Arabic, and went through numerous editions in different parts of Europe. The Papal court viewed with jealousy the proceedings of a society which devoted so much energy to the spread of knowledge, and, though Baptista Porta was a Roman Catholic, the meetings of the academy were prohibited by the ecclesiastical power. Although Baptista Porta was well acquainted with the writings of his predecessors, yet the principal invention recorded in his Natural Magic is that of the camera obscura, which he seems to have brought to great perfection. He remarks, in the 17th chapter of this work, that if a small aperture is made in the shutter of a dark room, distinct images of all external objects will be depicted on the opposite wall in their true colours; and he further adds that if a convex lens be fixed in the opening, so that the images are received on a surface at the distance of its focal length, the pictures will be rendered so much more distinct that the features of a person standing on the outside of the window may be readily recognised in his inverted image. Various attempts seem to have been made to obtain an erect image of objects in the camera obscura, but the contrivances for this purpose had the effect, as Baptista Porta assures us, of making the pictures so obscure that there was no pleasure in viewing them. He observes, however, that the image may be best rendered erect by receiving it "upon a concave mirror properly adapted to the convex lens and held at a great distance from the hole." The effect of this expedient, he says, cannot be sufficiently admired. Baptista Porta applied his instrument to the representation of eclipses of the sun, and of hunting scenes, battles, and other events produced by moveable pictures and drawings. In this way he magnified small objects and drawings, and produced the effects of the magic lantern by the light of the sun in place of that of a lamp. He considered the eye as a camera obscura, the pupil as the hole in the window contracting and dilating with different lights, and the crystalline lens as the principal organ of vision, though he seems to have regarded it not as his convex lens but as the tablet on which the images of external objects were formed, the cornea being, no doubt, in his estimation, the part of the eye which formed the picture. Baptista Porta was doubtless acquainted with what may be called the simplest form of the refracting telescope, namely, that in which a convex lens is the object-glass, and the eye placed six inches behind its focus, the eye-glass. He found that when his eye was thus placed behind a convex lens, he could read a letter which he could not read with his naked eye. His lens must have exceeded in focal length, the distance at which his eye saw distinctly, for the magnifying power of such a telescope is equal to the focal length of the object-glass divided by that distance.

In another place Porta, after mentioning the effects produced by a concave and a convex lens separately, remarks, "that if you knew how to combine one of each sort rightly, you would see both far and near objects larger and more clearly." "If Porta," says Mr. Drinkwater Bethune, in his admirable life of Galileo, "had stopped here, he might more securely have enjoyed the reputation of the invention, but he then professes to describe the construction of his instrument, which has no relation whatever to his previous remarks." "I shall now endeavour to shew in what manner we may contrive to recognise our friends at the distance of several miles, and how those of weak sight may read the most minute letters from a distance. It is an invention of great utility, and grounded on optical principles, nor is it at all difficult of execution; but it must be so divulged as not to be understood by the vulgar, and yet be clear to the sharp-sighted." The description which follows, seems far enough removed from the apprehended danger of being too clear; and indeed every writer who has hitherto quoted it, has merely given the passage in its original Latin, apparently despairing of an intelligible translation. With some alterations in the punctuation, which appear necessary to bring it into any grammatical construction, it may be supposed to bear something like the following meaning:—"Let a view be contrived in the centre of a mirror, where it is most effective. All the solar rays are exceedingly dispersed, and do not in the least come together (in the true centre); but there is a concourse of all the rays in the central part of the said mirror, half way towards the other centre, where the cross diameters meet. This view is contrived in the following manner: A concave cylindrical mirror placed directly in front, but with its axis inclined, must be adapted to the focus; and let obtuse angled, or right angled triangles be cut out with two cross lines on each side drawn from the centre, and a glass (*specillum)* will be completely fit for the purposes we mentioned." If it were not for the word *specillum*, which, in the passage immediately preceding this, Porta contrasts with *speculum*, and which he afterwards explains to mean a glass lens, it would be very clear that the foregoing passage, supposing it to have any meaning, must be referred to a reflecting telescope; and it is a little singular, that whilst this obscure passage has attracted universal attention, no one, so far as we are aware, has taken any notice of the following unequivocal description of the principal part of Newton's construction of the same instrument. It is in the fifth chapter of the seventeenth book, where Porta explains by what device exceedingly minute letters may be read without difficulty. "Place a concave mirror so that the back of it may lie against your breast; opposite to it and within the burning point, place the writing; put a plane mirror behind it, that may be under your eyes. Then the images of the letters which are in the concave mirror, and which the concave has magnified, will be reflected in the plane mirror, so that you may read without difficulty."[2]

On these grounds Porta claimed for himself the invention of the telescope; and his death which took place in 1615, at the age of eighty, is said to have been hastened by the exhaustion of writing a work on that instrument.

At a more advanced age, Baptista Porta composed another work entitled, *De Refractione Optices parte, libri novem*, which appeared in 1593, but contains nothing that is deserving of particular notice.

The subject of the rainbow, which had hitherto been a *questio vexata* among philosophers, now began to excite notice, as much from the absurdity of the theories which were advanced to explain it, as from the native interest of the subject. Clichtoveus, whom Dr. Priestley supposes to be the person who distinguished himself by his opposition to Luther, had maintained that the second rainbow was a reflected image of the first, not only from the faintness of its light, but from the inversion of its colours; an opinion which our celebrated countryman, Dr. Gilbert has justly ridiculed, alleging, that the whole form of the bow ought to be inverted as well as its colours, and that it ought to have its convex side downwards.

Clichtoveus. Died 1543.

A more correct theory of the rainbow was about this time proposed by J. Fleschier of Breslau, in his treatise entitled, *De Iridibus doctrina Aristotelis et Vitellionis*, which was published in 1571. He supposes the rays to suffer two refractions, one on entering, and the other on emerging

Fleschier. A.D. 157

[1] A second and greatly enlarged edition was published about thirty years afterwards. [2] *Life of Galileo*, Libr. Useful Knowledge, p. 21.

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from the drop, but after one ray had thus been separated into a coloured beam by these refractions, he supposed that this beam was reflected to the eye from another drop.

De Dominis. Born 1561. Died 1662.

These views, imperfect as they are, paved the way for the true theory of the rainbow. Antonio de Dominis, archbishop of Spalatro, first broached this theory in his treatise *De Radiis Visus et Lucis*, which was published in 1611. He justly asserts that two refractions in a drop of water, and one intermediate reflection, were sufficient to bring back to the eye of the spectator the rays of light by which the bow was formed. An experiment with a globe of glass enclosing water, either suggested to him or confirmed this opinion. In following out this experiment, however, our author committed several mistakes. He explained the exterior bow by the same number of refractions and one reflexion, but he supposed that the rays which formed it were returned to the eye by a part of the drop lower than that which transmitted the red of the interior bow. In addition to this mistake, he supposed that the rays which went to form one of the bows, came from the upper part, and that which went to form the other bow from the under part of the sun's disc. Notwithstanding these mistakes, De Dominis is entitled to be regarded as the true discoverer of the cause of the primary rainbow.

The treatise containing these discoveries was not published till after the use of the telescope by Galileo, but Bartolo, who published it, informs us in the preface, to use the words of the author of the *Life of Galileo*, "that the manuscripts was communicated to him from a collection of papers written twenty years before, on his enquiring the archbishop's opinions with respect to the newly discovered instrument, and that he got leave to publish it, 'with the addition of one or two chapters.' The treatise contains a complete description of a telescope, which, however, is proposed merely to be an improvement on spectacles; and if the author's intention had been to interpolate an after-written account in order to secure to himself the undeserved honour of the invention, it seems improbable that he would have suffered an acknowledgment of additions, previous to publication, to be inserted in the preface. Besides, the whole tone of the work is that of a candid and truth-seeking philosopher, very far indeed, removed from being, as Montucla calls him, conspicuous for ignorance even among the ignorant men of his age. He gives a drawing of a convex and concave lens, and traces the passage of the rays through them; to which he subjoins, that he has not satisfied himself with any determination of the precise distance to which the glasses should be separated according to their convexity and concavity, but recommends the proper distance to be found by actual experiment, and tells us that the effect of the instrument will be to prevent the confusion arising from the interference of the direct and refracted rays, and to magnify the object by increasing the visible angle under which it is viewed."[1]

From the great liberality of his sentiments, and his conversion to the protestant faith, this eminent ecclesiastic was obliged to leave Italy, and to take refuge in London, in 1616, where he lived some years. Having been induced to return to Italy, his imprudence exposed him to new persecutions, and having been imprisoned by Urban VIII. he died of poison in the prison of the Inquisition. Sentence was passed upon him after his death, and his body, with all his books and papers were publicly burnt in the Campo de Fero, in the year 1624.

Invention of the telescope.

We now approach the time when the telescope was unquestionably invented. We have no doubt that this invaluable instrument was invented by Roger Bacon or Baptista Porta, in the form of an experiment, though it perhaps had not in their hands assumed the maturity of an instrument made for sale, and applied to useful purposes both terrestrial and celestial. If a telescope is an instrument by means of which things at a distance can be seen better than by the naked eye, then Baptista Porta's concave lens with his eye looking at the image which it formed, and reading a letter too remote to be otherwise legible, was a real telescope; but if we give the name to a tube having a convex object glass at one end, and a convex or a concave lens at the other, placed at the distance of the sum or the difference of their focal lengths, then we have no distinct evidence that such an instrument was used before the beginning of the seventeenth century.

In his *Treatise on Dioptrics*, Descartes has ascribed the invention of the telescope to James Metius, a citizen of Alkmaer in Holland; but Huygens in mentioning this claim[2] says, that "*to his certain knowledge* telescopes were made before this, at Middleburg in Zealand, about the year 1609, either by John Lippersheim, whom Sirturus mentions, or by Zacharias (Jansen), whom Borellus makes the first inventor of them in his book *de Vero Telescopii inventore*. The telescope which they made did not exceed a foot and a half long. But much earlier than both, Joannes Baptista Porta a Neapolitan, had delivered the rudiments of this art in his book on dioptrics and natural magic, published fifteen years before telescopes appeared in our Belgium. In these books he speaks of his *specilla* as shewing things placed at a distance as if they were nigh, and also of the construction of concave and convex lenses. But that he made no great progress in this art is hence evident, that in all that time it did not become famous; and that he did not discover any of those things in the heavens that were observed afterwards. And this shews that his invention was not owing to his skill, but to some accidental experiments. For though he had some degree of knowledge in mathematicks, yet he did not understand those fundamental principles and abstruse theorems in dioptricks, that are necessary to invent a telescope by reason; and by much less did those illiterate mechanicks that I mentioned before. But no wonder that good luck and casual experiments should produce this effect; after spectacles and concave glasses, for defective eyes of both sorts, had been commonly used for above three hundred years, it is rather surprizing that so obvious a thing should be so long unknown."

In this passage Huygens leaves the claims of his two Dutch friends on the same level; but though Borellus adopts the conclusion that Jansen was the inventor, yet it has been ingeniously suggested, that Jansen's claim as the inventor of the microscope, has been mixed up with the invention of the telescope, on the evidence adduced by Borellus. On this hypothesis Lippersheim is supposed to have invented the telescope by accident in 1609, and that Jansen possessing an instrument so like it, had been able, after hearing of Lippersheim's contrivance, to make a similar instrument without having seen the telescope of his rival.[3]

Much light has recently been thrown on the history of the telescope by Professor Moll, who has discussed the claims of the various competitors with much sagacity and fairness. It appears from the official acts and journals of the States General of Holland, still existing among the archives at the Hague, that on the 2d of October 1608 that body took into consideration a petition from Hans (John) Lippershey, a native of Wesell, and spectacle maker at Middleburg, praying, that an instrument which he had invented for seeing at a distance, might be rewarded, either by granting an exclusive privilege of making it for thirty years, or an annual pension to enable him to make these instruments for Holland alone. It was resolved, that a commit-

[1] *Life of Galileo*, Libr. Useful Knowledge, p. 22. [2] *Dioptrics*, p. 163–4. [3] *Life of Galileo*, Libr. Useful Knowledge, p. 24.

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tee should communicate with the petitioner, and enquire if he could not so improve the instrument *so as to enable one to look through it with both eyes.* Lippershey offered to make three telescopes of *rock crystal* for *one thousand florins* each, (about L.83 each) but the committee was instructed to get him to moderate his charge, and promise never to transmit his invention to any body. On the 6th of October a bargain was made that Lippershey should construct one instrument of rock crystal for the State, at the price of 900 florins, (L.75) 300 florins to be paid down, and 600 when the telescope was completed and approved of. On the 16th December the committee report, "that they examined the instrument invented by Lippershey to see at a distance *with two eyes*, and that they approved of it." But, in reference to the exclusive privilege, they "resolved that, whereas it appears *that many other persons have a knowledge of this new invention* to see at a distance, it is expedient to refuse the prayer of the petitioner for an exclusive privilege, but that he will be commanded to make, within a certain time, two other instruments of his invention for seeing with two eyes, at the same price." These two new instruments were delivered before the 13th February 1609.

While these transactions were going on, Jacob Adriaansz, sometimes called Metius of Alkmaer petitioned the States-General on the 17th of October 1608, for an exclusive privilege for a similar instrument. He was the third son of Adriaan Anthonisz, or Metius, who discovered the approximate ratio of the diameter of a circle to its circumference. His petition still exists among the manuscripts of Huygens, in the library at Leyden. He alleges, that he began his researches as far back as 1606; that the invention was accidental, and when he was making other experiments; and that, in 1608, when he sent in his petition, his instrument was made of bad materials. He at the same time readily admits, that a spectacle maker of Middleburg had offered before him a similar instrument to the States, which had been tried by Prince Maurice, and other persons.

With regard to the claims of Zacharias Jansen, or rather Tansz or Zansz, they cannot be supported by any evidence, and there is reason to believe, as we shall afterwards see, that his invention of the microscope was mistaken for the invention of the telescope[1] The following is Professor Moll's summary of the facts which he has established by authentic documents.

"That on the 21st of October 1608, John, or Hans Lippershey, a native of Wezel, a spectacle maker of Middleburg, in Zeeland, was actually in possession of the invention of telescopes.

"That, on the 17th of October, of the same year 1608, Jacob Adriaansz, sometimes called Metius of Alkmaer in Holland, also was in possession of the art of making telescopes, and that he actually made those instruments; but that either from disgust or some other reason, he afterwards concealed his invention, and thus actually gave up every claim attached to the honour of it.

"That there is little reason to believe that either Hans, or his son Zacharias Zansz, were also inventors of the telescope; but there is every probability that this Hans, or John, or his son Zacharias Zansz, invented a compound microscope about 1590.

"That this Lippershey used rock or mountain crystal in the construction of telescopes, and that he is the inventor of the Binoculus."

Galileo's construction of the telescope. A.D.1609.

When Galileo was at Venice in 1609, he heard rumours that an instrument which represented distant objects as if they were near, had been invented by a Dutch spectacle maker. This rumour was confirmed by a letter which he received from James Badorere at Paris, and Galileo, who asserts that he had never seen one of the instruments, set himself to discover the principle of their construction, and to make one for his own use. It has become a question, though one of no interest, and affecting the veracity more than the reputation of Galileo, whether the Italian philosopher had actually seen one of the new instruments. We cannot hesitate for a moment in believing Galileo's assertion; and even if we confide in the statement made by Fucarius, that he had himself seen one of the Dutch telescopes, which at that time had been brought to Venice, it by no means follows that Galileo saw it.[2] It is quite certain, indeed, that previous to the 31st August 1609, one of the new perspective glasses had been sent from Flanders to the Cardinal Borghese,[3] and Lorenzo Pignoria, on the authority of whose letter of the above date this fact rests,[4] adds, "we have seen *some* here, and truly they succeed well."

The following is Galileo's account of the matter, from a letter which he wrote in March 1610: "It is about ten months ago that it came to our ears, that a glass had been worked by a Belgian, by the help of which, visible objects, though at a great distance from the eye of the observer, may be seen distinctly. (In the Italian of the Saggiatore it is added, *ne pia aggiunto, no more was added, or this was all.)* And some experiments were related of the admirable effects of this instrument, which some believed, and others not. A few days afterwards the same was confirmed by letters of a noble Frenchman, Jacob de Badorere, from Paris; all which occasioned me to apply myself wholly to enquire into the cause of this, and to think on the means by which the invention of a similar instrument might be brought about; in which I succeeded in a short time, assisted by the doctrine of refraction: and I first procured a leaden tube, (an organ pipe) at the end of which I adapted spectacle glasses, both plane on one side, the one convex on the other side, the second concave. Bringing the eye near the concave glass, I saw the objects large, and near enough: they appeared three times nearer, and nine times larger, than if seen with the naked eye.

"Afterwards I made another instrument, which made objects appear sixty times larger.

"Finally, sparing neither industry nor expence, I succeeded so far as to make an instrument of such excellence, as to make the objects seen through it appear a thousand times larger, and more than thirty times nearer, than if seen with the natural power of the eye."[5]

Galileo's first telescope must have been made in May or June 1610. Viviani[6] says, that it was in April or May 1609, that the rumour of the invention of the telescope reached Venice, when Galileo was there, and that, with this information only, Galileo returned to Padua and succeeded in finding out the principle in the following night.

The new instrument long went by the names of Galileo's *tube*, the *perspective*, and the *double eye-glass*, the

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[1] Professor Moll's interesting Researches on the History of the telescope, will be found in the Journal of the Royal Institution, Lond. 1831, vol. i. p. 319, 483.

[2] Fucarius does say that Galileo saw it. Galileo may have seen many Dutch telescopes *after* he had reinvented the instrument.

[3] Ib. p. 23.

[4] The following is the passage: "We have no news except the return of his Serene Highness, and the re-election of the lecturers, among whom Signior Galileo has contrived to get 1000 florins for life; and it is said to be on account of an eye-glass like the one which was sent from Flanders to Cardinal Borghese. We have seen some here, and truly they succeed well."

[5] Moll, Journal of the Royal Institution, vol. i. p. 488.

[6] Viviani vita del Galileo, p. 69.

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more appropriate names of telescope and microscope having been afterwards given to these instruments by Demisiano.

Telescopes in England, A.D. 1609. Harriot.

Telescopes were early and eagerly imported into England, and known by the name of *trunks* and *cylinders*; and so soon as July 1609, we find that our countryman Harriot was directing them to the lunar disc, and had begun two full drawings of that luminary, which he afterwards completed.[1] Harriot's earliest observations on Jupiter's satellites were made on the 1st October 1610, nine months after their discovery by Galileo. The earliest telescope in England must therefore have been obtained from Holland; and in a letter from Sir William Lower to Harriot, dated *the longest day of* 1610, from Traventi in Caermarthenshire, he says, "we are here so on fire with these things, that I must render my request and your promise, to send more of all sorts of these cylinders. My man shall deliver you monie for anie charge requisite, and contente your man for his paines and skill. Send me so many as you think needful unto these observations: in requital I will send you store of observations. Send me also one of Galileus bookes, if anie yet be come over, if you can get them." In a letter dated July 6, 1610, Sir Christopher Heyden writes to his friend Camden, "I have read Galileus, and to be short, do concur with him in opinion, for his reasons are demonstrative; and of my own experience with one of our ordinary trunks, I have told eleven stars in the Pleiades, whereas no age ever remembers above seven, and one of these, as Virgil testifieth, not always to be seen."[2] From this and other facts, Professor Rigaud infers "that it is perfectly clear that Harriot and his friend had been in the habit of using telescopes before the discoveries of Galileo were known to them; and it appears likewise that in 1610,[3] they were manufactured in England." The magnifying power of some of the telescopes used by Harriot were $\frac{6}{1}$, $\frac{10}{1}$, $\frac{11}{1}$, $\frac{15}{1}$, $\frac{32}{1}$, $\frac{50}{1}$. In a letter from Sir William Lower to Harriot, dated Traventi, 6th July 1610, he says, "I have received the perspective cylinder that you promised me, and am sorrie that my man gave you not more warning, that I might have had also the two or three more that you mentioned to chuse for me. Henceforward he shall have orders to attend you better, and to defray the charge of this an others, for he confesseth to me that he forgot to pay the worke man.

"According as you wished, I have observed the moone in all his changes. In the new I discover manifestlie the earthshine a little before the dichotomie; that spot which represents unto me the man in the moone (but without a head) is first to be seene. A little after, neare the brimme of the gibbous parts, towards the upper corner, appeare luminous parts like starres, much brighter than the rest; and the whole brimme along lookes like unto the description of coasts in the Dutch bookes of voyages. In the full she appears like a tarte that my cooke made me the last weeke. Here a vaine of bright stuffe, and there of darke, and so confusedlie al over. I must confesse I can see none of this without my cylinder; yet an ingenious younge man that accompanies me here often, and loves you and these studies much, sees manie of these things, even without the helpe of the instrument, but with it sees them most plainlie, I mean the young Mr. Protheroe."

Astronomical telescope invented by Kepler, A.D. 1611.

It is highly probable that the first Dutch telescopes had their eye-glass concave, like Galileo's, though this supposition is opposed by the traditional story of a large and inverted image of a weathercock having been seen through the earliest of them, in which case the eye-glass must have been convex. Even so late as the period when Descartes published his *Dioptrics*, which was in 1637, no other telescope but a Galilean one had been described, excepting in Kepler's *Dioptrica*, which appeared at Frankfort in 1611. In his 86th proposition he explains the theory of the telescope, and has shewn how an instrument which produces the same effects might be made, by substituting for the usual concave eye-glass *one or more convex* eye-glasses. Kepler, however, does not seem to have constructed such a telescope, and father Scheiner[4] seems to have been the first person who embodied the plan in an actual instrument, which has ever since been known by the name of the *astronomical telescope*, in consequence of the inversion of the images not being disagreeable in astronomical observations.

Inventi[on] of the [mi]croscope. Janse[n].

The real inventor of the compound microscope is as little known as the inventor of the telescope. It would be in vain to inquire into the history of the single microscope, for the magnifying power of globes was known to the ancients; and no individual ambition or national partiality has endeavoured to assign the honour of inventing it to any person whatever. We agree with Professor Moll, that Zacharias Zansz, or Jansen, has the best claims to be considered as the inventor and constructor of the compound microscope. He seems to have made one so early as 1590, and to have presented one to the Archduke Albert of Austria, who gave it to Cornelius Drebell, who lived, as mathematician to the king, at the court of our James the First. William Boreel, the envoy to England from the States of Holland, saw in England, in 1619, and in the hands of Cornelius Drebell, the very microscope which Tansz had given to the archduke. This account of its history was given by Drebell himself. The microscope in question was eighteen inches long, consisting of a tube of gilt copper two inches in diameter, supported by two sculptured dolphins, resting on a base of ebony, upon which the objects were placed.

Font[ana].

M. Fontana, a Neapolitan, first described the compound microscope, consisting of two convex lenses, in his work entitled *Novæ Terrestrium et Celestium Observationes*, which appeared in 1646, but claims to have made the discovery so early as 1618, though he does not adduce any evidence whatever of this fact. Huygens, on the contrary, says, "It does not appear that these microscopes were made in the year 1618, because Sirturus, who published a book that year about the origine and construction of telescopes, would hardly have been silent upon so remarkable an invention, if it had been thus known. Fontana, indeed, lays claim to it from the year 1618, in his book of *Observations*, published in 1646; but the testimony of Lyrsalis, there printed, goes no higher than the year 1625. But that my countryman Drebelius made these compound microscopes at London in the year 1621, I have often been informed by several eye-witnesses, and that he was then reckoned the first inventor of them."

This testimony of Huygens in favour of Drebell, is in direct contradiction to the statement said by Borelli to have been made to the Dutch envoy in 1619.

Galil[eo] [...]he proba[bly] inven[tor] of the mi[cro]scope, [A.]D. 1612.

In consequence of this conflicting evidence, Galileo may be regarded as having the best claim to the invention of the compound microscope. Viviani distinctly informs us in his *Life of Galileo*, that he was led to the invention of the microscope by that of the telescope, and that in the year 1612, he actually sent a microscope in a present to Sigismund King of Poland. Having been dissatisfied with the performance of this instrument, he seems to have devoted himself twelve years afterwards to its improvement; and in a letter to P. Frederigo Cesi, he says that he had delayed to send him the microscope, the use of which he describes, as he had only then brought it to perfection, owing to the difficulty he experienced in making the glasses.[5] In his *Magic of Nature*, Schottus mentions a singular accident which took place with one of the newly invented microscopes.

1 Rigaud's *Supplement to Bradley's Miscellaneous Works*, p. 20, 21.
2 Camden, *Epistolæ*, p. 129, quoted by Professor Rigaud.
3 Before February.
4 *Rosa Ursina*. 1650.
5 *Life of Galileo*, Libr. Usef. Knowledge, p. 25.

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A Bavarian philosopher, when travelling in the Tyrol, was taken ill on the road and died. The village authorities found a little glass instrument in his pocket, which happened to contain a flea fixed in the focus of the microscope. Upon looking into the eye-glass, they were struck with terror at the sight of the gigantic animal, and the remains of the poor philosopher, who was then proved to be a sorcerer, were pronounced unworthy of Christian burial. Some bold sceptic, however, explored the mystery, and produced the giant which had alarmed them.[1]

Discoveries of Kepler. Born 1571, died 1630.

The name of Kepler, though associated principally with astronomical discovery, will ever be venerated by the cultivators of optical science. His researches, which relate principally to vision and refraction, are contained in his *Paralipomena ad Vitellionem*, published at Frankfort in 1604, and in his *Dioptrica*, already referred to. His discoveries respecting vision, though founded to a certain degree on the views of Maurolycus and Baptista, are nevertheless to a great extent original. He was the first person who actually shewed that distinct and inverted images of external objects are formed upon the retina, as in the camera obscura, by the foci of pencils emanating from every point of the object. He explained all the phenomena of distinct and indistinct vision, and shewed how that indistinctness could be removed by the use of convex and concave glasses. Although D'Alembert[2] has asserted that all optical writers before him had assumed it as an axiom that every visual point is seen in the direction of its visual ray, yet, as Dr. Wells has observed, this assertion is not well founded, for Kepler had long ago maintained that objects are perceived not along the visual rays, but along lines which pass from their pictures on the retina through the centre of the eye; an opinion in which he has been followed by Dechales and Dr. Porterfield, to the last of whom Dr. Reid has by mistake ascribed the discovery of this law. Hence Kepler was led at once to the true theory of erect objects being seen from inverted images, which he considered as the business of the mind, which, when it judges of an impression made on the lower part of an inverted image on the retina, considers it as made by rays proceeding from the higher parts of an erect object, a necessary consequence of his opinion that objects are perceived in lines passing through the centre of the retina. Kepler has wisely declared his ignorance of the manner in which the mind perceives images on the retina, and he blames Vitellio for attempting the solution of a question which does not belong to optics. In order to explain the adaptation of the eye to different distances, Kepler supposed that the ciliary processes draw the sides of the eye towards the crystalline lens, by which change the globe of the eye is elongated, and the retina placed at a greater distance from the crystalline, so as to accommodate the eye to the distinct vision of near objects.

The refraction of light in its passage through different media, is treated at great length, but very unsatisfactorily, by Kepler. Although he failed in his attempts to discover the law of refraction, yet he arrived at certain rules of refraction for glass, which enabled him to discover many of the leading principles of convex and concave lenses. He found, for example, that below 30° of incidence, the angle of refraction was nearly two-thirds of the angle of incidence; that at 90° of incidence the angle of refraction was 42°; and that if the refracted ray fell at a greater obliquity than 42°, upon the interior surface of glass, it would be totally reflected back again into the glass at an angle equal to that of incidence. He then shews, by applying these principles, that plano-convex lenses of glass have their foci at a distance from the lens equal to the diameter of the sphere of which their convex surface is a portion, and that equi-convex lenses have their focal length equal to the radius of the sphere of which their convexities are a portion. When the lens has its surfaee unequally convex, he makes the focal length equal to a mean of the radii of the two spheres. The same properties being proved in reference to concave lenses, Kepler proceeds to find the focus of refracted rays, when they radiate from points at different distances from the lens. He proved also that rays issuing from the focus of a lens will emerge on the other side of it parallel; that if they issue from a point between the focus of the lens, they will diverge after refraction, while those which issue from a point beyond the focus will converge; and, finally, that when the distance of the radiant point is equal to twice the focal length of the lens, the distance of the image will be equal to the distance of the object.

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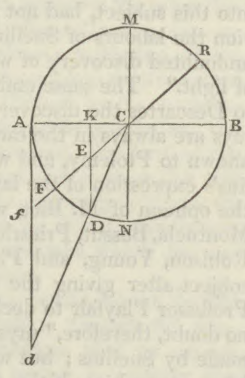
In treating of the refraction of the atmosphere, Kepler remarked that the quantity of refraction would alter if the atmosphere varied in weight, and that it would be different at different temperatures. In one of his letters to Bregger, dated in 1605, on the colours of the rainbow, he makes the following observation:—"The sun's rays are not coloured except with a definite quantity of refraction. Whether you are in the optical chamber, or standing opposite glass globes, or walking in the morning dew, every where it is obvious that a certain and definite angle is observed, under which, when seen in dew, in glass, in water, the sun's splendour appears coloured, and under no other angle. There is no colouring by mere reflexion, without the refraction of a clearer medium."[3]

Snellius discovers the law of refraction, A.D. 1621

Although Tycho and Kepler made many ineffectual attempts to discover the law of refraction, yet the honour of that great discovery was reserved for Willebrord Snellius, Professor of Mathematics at Leyden, who died at the age of thirty-five, leaving behind him a manuscript work on the subject. The doctrine of refraction having become more important after the invention of the telescope, Snellius devoted himself to its investigation, and "after many troublesome experiments and attempts," succeeded in his research. Supposing AB to be the refracting surface of water, an object under the water at D appeared as if it were raised and seen in the line RC. He then produced RC till it intersected at E a line DK drawn parallel to the perpendicular MN, and he asserted that at every angle at which the object D was viewed, it would appear at E, and that CD was to CE in a given ratio, such as 4 to 3, when the refracting body was water. Now this is a true geometrical expression of the law of refraction, though the same truth may be better enunciated in other two ways. If we continue the lines CE CD, till they meet Ad, a line perpendicular to AD, in the points f and d, then on account of the parallels Ad, KD; CD is to CE as Cd is to Cf; but ACd is the complement of the angle of refraction, and ACf the complement of the angle of incidence, and Ad, Af are their secants. Hence it follows from Snellius' result, *that the cosecants of the angles of incidence and refraction are in a constant ratio*, which is a correct mathematical expression of the law of refraction. Again, in the triangle CDE, the sides CD CE are to one another as the Sines of the opposite angles, that is, as the Sines of the angles DEC or KEC, or ECN or RCM, and of CDE or DCN; that is *the sines of the angles of incidence and refraction are*



[1] *Life of Galileo*, Libr. Usef. Knowledge, p. 27.
[2] *Opuscules Mathematiques*, tom. i. p. 265.
[3] *Life of Kepler*, Libr. Usef. Knowledge, p. 17.

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in a constant ratio, which is the usual and most distinct expression of the law of refraction. In giving this law of Snellius', Huygens has in our opinion forgotten his usual courtesy, when he states that Willebrord Snellius did not "thoroughly comprehend his own invention," and "never imagines that the ratio was the ratio of the Sines." Now we cannot conceive it possible that a man like Snellius, who was a good geometer, was ignorant of the two simple trigonometrical expressions of his geometrical law; and we do not doubt that he preferred his own for two distinct reasons. In the first place, it connects itself with the leading physical phenomena of the apparent rise of the refracted object from D to E, and by substituting CF for CD it furnishes us with a much more simple and accurate method of obtaining by projection the refracted ray from the incident one. If RF for example, is the incident ray, we have only to divide CF into two parts, CE, EF, so that CF is to CE in the constant ratio belonging to the refracting body.

But whether we are right in this conjecture or not, it is an unquestionable truth that Snellius discovered the *true law* of refraction, though he did not express it in trigonometrical language.

Descartes. Born 1596, died 1650.

In the year 1637, about eleven years after the death of Snellius, Descartes published his *Dioptrics*, in which, without ever mentioning the name, or alluding to the labours of Snellius, he announces the true law of refraction expressed in term of the Sines, as the result of his own enquiries. As Snellius's work existed only in manuscript, it was quite possible that Descartes knew nothing of its contents, but Vossius, in his work *De Natura Lucis*, states, that the heirs of Hortensius had communicated freely to Descartes the manuscripts of that professor, among which was that of Snellius's work, and Huygens confirms this allegation when he states in his Dioptrics that he had himself seen the whole manuscript volume of Snellius, and had heard that Descartes had also seen it,[1] and that it was perhaps from hence that he deduced (elicuerit) that measure which consists in the Sines. We should not have entered so minutely into this subject, had not M. Biot[2] thrown into entire oblivion the labours of Snellius, and ascribed to Descartes the undoubted discovery of what he calls "this great property of light." The same eminent philosopher likewise ascribes to Descartes the discovery that the incident and refracted rays are always in the same plane, a truth which was well known to Ptolemy, and which is clearly included in Snellius's expression of the law of refraction. In opposition to the opinion of M. Biot, we must place those of Huygens, Montucla, Bossut, Priestley, David Gregory, Smith, Hutton, Robison, Young, and Playfair; and we shall dismiss the subject after giving the admirable reasons which induced Professor Playfair to decide against Descartes. "There is no doubt, therefore," says he,[3] "that the discovery was first made by Snellius; but whether Descartes derived it from him, or was himself the second discoverer, remains undecided. The question is one of those, where a man's conduct in a particular situation can only be rightly interpreted from his general character and behaviour.

"If Descartes had been uniformly fair and candid in his intercourse with others, one would have rejected with disdain a suspicion of the kind just mentioned. But the truth is, that he appears throughout a jealous and imperious man, always inclined to depress and conceal the merit of others. In speaking of the invention of the telescope, he has told minutely all that is due to accident, but has passed carefully over all that proceeded from design, and has incurred the reproach of relating the origin of that instrument without mentioning the name of Galileo. In the same manner, he omits to speak of the discoveries of Kepler, so nearly connected with his own; and, in treating of the rainbow, he has made no mention of Antonio de Dominis. It is impossible that this should not produce a favourable impression; and hence it is that the warmest admirers of Descartes do not pretend that his conduct towards Snellius can be completely justified.

"Descartes would have conceived his philosophy to be disgraced if it had borrowed any general principle from experience, and he therefore derived, or affected to derive the law of refraction from reasoning or from theory."

Even if Descartes had liberally taken from his optical wreath the law of the Sines, and generously placed the hallowed branch on the brow of the accomplished Snellius, he would have added to his reputation as a man, without shortening his immortality as a philosopher. His Dioptrics consists of ten chapters. The first treats of light, the second of refraction, the third of the eye, the fourth on lenses in general, the fifth on the images formed on the bottom of the eye, the sixth on vision, the seventh on the mode of perfecting vision, the eighth on the figures which transparent bodies require to turn the rays by refraction, suited to all modes of vision, the ninth on microscopes, and the tenth on the mode of polishing glasses. The inability of spherical surfaces to converge rays to one point or focus, had been long known to opticians, and Kepler, though he conjectured that surfaces generated by the revolutions of the conic sections, might have such a property, left the subject just as he found it. Descartes, however, has discussed it in a most ingenious manner, in the eighth chapter of his Dioptrics. He has shewn how parallel, and converging, and diverging rays may be brought to accurate foci by means of ellipsoidal and hyperboloidal surfaces, so that if such surfaces, could be executed by opticians, all optical instruments would receive the highest degree of perfection which they could attain from the removal of spherical aberration. In order to carry this system into effect, he contrived machines for grinding elliptical and hyperbolical lenses, and in the tenth chapter of his Dioptrics he has given perspective drawings and descriptions of them. In the years 1627 and 1628, when he was residing at Paris, M. Mydorgius, with whom he lived on the most intimate habits, urged him to undertake the grinding of hyperbolical and elliptical lenses, and he soon became a great master of the art of glass grinding. He found it necessary, however, to associate with himself in this undertaking an eminent artist, M. Ferrier, who, as an optical instrument maker, was well acquainted both with the theory and the practice of his art. After many failures, a tolerably good hyperbolic convex lens was completed; but the concaves were found to be more difficult; and in consequence of M. Ferrier refusing to accompany Descartes to Franeker, and having occasioned him much needless expence in the erection of his laboratory, a quarrel took place, and the great practical object which they had in view was for a while abandoned. Descartes, however, was sanguine in his expectations, and not aware that there was another aberration more difficult to overcome than that of spherical figure, he expected to be able to make the greatest discoveries in the heavens by means of his new lenses. With the assistance of M. Huygens, the father of the celebrated philosopher, he induced some Dutch artists to renew the attempts of Ferrier; but these and his subsequent endeavours to construct such lenses have failed, though we cannot allow ourselves to think that the attempt is a hopeless one.

Descartes made some interesting observations upon vision, particularly on the method by which we judge of the distances and magnitude of objects; but his principal discovery in physical optics relates to the theory of the rain-

[1] Bossut is incorrect in saying that Huygens *assures us* that Descartes saw the manuscript volume of Hortensius. His words are, "*et Cartesium quoque vidisse accepimus.*" (*Dioptrica*, p. 3.)

[2] *Traité de Physique*, tom. iii. p. 204, 205.

[3] Professor Playfair's Dissertation in this Work, vol. ii. p. 101.

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bow. He discovered the true cause of the exterior rainbow, and in his *Traité des Meteores*, proves that it was produced by two refractions, and two intermediate reflections within the drop, thus explaining most satisfactorily the faintness of its illumination, and the inversion of its colours. He has clearly shewn also, why the interior bow is 42° in diameter, while the exterior one is 52°; though he did not understand the true origin of the colours. We regret to add, that Descartes gives his explanations of both the interior and exterior bows without ever mentioning the name of Antonio de Dominis, who was the real discoverer of the cause of the rainbow; and our regret is increased, when we are compelled to add, that M. Biot has, contrary to the opinion of all philosophers, given his aid to Descartes in depriving the Italian philosopher of the only discovery which has immortalised his name.[1]

Christopher Scheiner. Born 1575, died 1650.

The science of optics is under considerable obligations to Christopher Scheiner, a Jesuit, and professor of mathematics at Ingolstadt. He completed the theory of vision in so far as he proved by direct experiment that the pictures of external objects were distinctly delineated on the retina. By paring away the coats from the back of the eyes of sheep and oxen, and also the human eye, he made the inverted pictures distinctly visible, and exhibited the experiment publicly at Rome in 1625. In his work entitled *Oculus*, published in 1652, he speaks of the great resemblance of the eye to the camera obscura, and gives various contrivances for erecting the images. He adopts the theory of Kepler respecting the visible direction of objects, and he observed the interesting fact that the pupil of the eye is dilated in viewing distant, and contracted in viewing near objects. In measuring the refractive powers of the humours of the eye, he makes that of the aqueous humour differ little from that of water, and that of the crystalline humour differ little from that of glass, ascribing to the vitreous humour an intermediate refractive power. By tracing the progress of the visual rays through all the humours of the eye, he demonstrates that the retina, and not the crystalline lens, is the seat of vision; and he describes some interesting experiments respecting vision through one or more small apertures. We owe also to Scheiner the interesting experiment of exhibiting on the wall of a darkened room the disc of the sun with all its spots by means of a telescope. When Kircher afterwards describes this appearance he represents the spectator as "fixed with the utmost astonishment."

Double refraction of light discovered by Bartholinus, A. 1669.

A new and very interesting branch of optics had begun to excite the attention of philosophers, namely that of the double refraction of light. Erasmus Bartholinus, a physician at Copenhagen, and the author of several excellent works on geometry, received from some Danish merchants that frequented Iceland, "a crystal stone like a rhombic prism, which, when broken into small pieces, kept the same figure." With this substance, which was called *Iseland spar*, from its locality, Bartholinus made a number of experiments both chemical and optical, and he has published an account of the optical results which he obtained in a small volume which appeared at Copenhagen in 1669, under the title of *Erasmi Bartholini Experimenta Crystalli Islandici, Disdiaclastici quibus mira et insolita Refractio detegitur*, and is dedicated to Frederick III. king of Denmark. In *seventeen* experiments and *twelve* propositions this able and sagacious philosopher has presented us with an excellent summary of the more prominent phenomena of double refraction. He has shewn that Iceland spar has the property of double refraction, that is, of giving two images of all objects seen through it, whether its faces are parallel or inclined, like those of a prism; that the incident light is equally divided between these two pencils; that one of these refractions is performed according to the law of Snellius, the ratio of the Sines being as 1 to 1·667, but that the other is performed according to an extraordinary law which had not previously been observed by philosophers. He observed also a position in which the object appears six-fold, but he did not discover that this took place only in some specimens which were composite or irregular crystals.

Discoveries of Huygens. Born 1629, died 1695.

These discoveries of Bartholinus having been communicated to the Royal Society of London, and printed in No. 67 of their *Transactions*, they attracted the notice of Christian Huygens, a celebrated Dutch philosopher of the finest genius and the highest attainments. Having given a new theory of refraction, he wanted to repeat Bartholinus's experiments principally with the view of ascertaining if they opposed any difficulties to that theory. His work on this subject, entitled *De l'estrange Refraction du Cristal d'Islande*, which forms the 5th chapter of his *Traite de la Lumiére*, was written in 1678, and was read to Cassini, Roemer, and De la Hire, and to several other members of the Royal Academy of Sciences, which he had been invited to join by the liberality of the French king; but it was not published till 1690, when he was resident at the Hague. After giving Bartholinus the credit of having discovered some of the principal phenomena of double refraction, he describes the general properties of Iceland spar in forming two images of objects, and he shews that all the phenomena are related to the axis, or that diagonal of the rhomb, in the direction of which the crystal has no double refraction. He proves that the double refraction, or separation of the two images, gradually increases as the inclination of the refracted ray to the axis increases, and becomes a maximum in a plane at right angles to the axis. In the few preceding chapters of his *Traité de la Lumiére* he had explained all the phenomena of reflexion and refraction upon a new theory, in which he supposes light to be produced in the same manner as sound, by means of undulations propagated in an elastic ethereal medium, an hypothesis revived by Euler and extended by Dr. Young, and now almost universally embraced under the name of the undulatory theory. In applying the same theory to explain the phenomena of double refraction, he supposes the ray produced by the *ordinary* refraction of the medium to be produced by *spherical* undulations propagated through the crystal, while the ray formed by the *extraordinary* refraction is produced by *spheroidal* undulations, the ratio of the two refractions, determining the form of the generating ellipse. Huygens then proceeds to shew that this theory affords, by calculation, results agreeing very exactly with those which he had obtained by direct experiment. This discovery is perhaps the most splendid which has occurred in the history of optical science.

Discovery of the polarisation of light.

When Huygens had finished his researches on double refraction, he discovered what he calls a "wonderful phenomenon,"[2] and, though he acknowledges that we cannot find the cause of it, yet he thinks it proper to indicate the phenomenon that others may inquire into it. This discovery is that of the *polarisation of the light*, which forms the two pencils of Iceland spar, and he confesses that he must add to his theory other suppositions in order to explain it, though he thinks that a theory confirmed by so many proofs will still preserve its plausibility *(vraisemblance)*. Huygens had naturally supposed that the light which composed the two pencils was like all other light, but upon transmitting the two rays formed by one rhomb of calcareous spar through another rhomb, he was astonished to perceive that when the two rhombs were similarly placed as if they had formed one larger one, neither of the rays suffered double refraction in

[1] In his Optics, book ix. p. 147, Sir Isaac gives almost the whole merit of the explanation of the rainbow to De Dominis. He says, "the same explication Descartes hath pursued in his *Meteors*, and *mended that of the exterior bow*."

[2] "Une *phénomène merveilleux*, que j'ay decouvert après avoir écrit tout ce que dessus." (*Traité de la Lumiére*, p. 88.)

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passing through the second rhomb, the ordinary ray from the first being only ordinarily refracted by the second rhomb, and the extraordinary ray only extraordinarily refracted. The same thing took place when one of the rhombs, the second, for example, was turned round 90°, with this difference, that the ordinary ray of the first rhomb suffered only extraordinary refraction, and the extraordinary ray only ordinary refraction from the second rhomb. But in all other positions of the second rhomb, excepting these two rectangular ones, the ordinary and extraordinary rays of the first rhomb were each divided into two by the second rhomb, so that there were now *four* rays sometimes of equal but generally of unequal brightness, and such that the light of all the four never exceeded that of the single ray incident on the first rhomb.

Huygens discovered also the double refraction of quartz, or rock crystal, but he committed a great mistake in supposing that its double refraction was regulated by an entirely different law, the light being in this case *propagated through it in two spherical waves, one of which was a little slower than the other.*[1] This result he mentions in his preface as having been obtained after he had read his work to his colleagues in the Academy of Sciences. It is, however, founded on an incorrect observation, as the extraordinary refraction of rock crystal is produced by spheroidal undulations like that of Iceland spar, with this difference only, as afterwards discovered by M. Biot, that the spheroid is a prolate one.

Even if Huygens had not immortalised his name by these great discoveries, his treatises on dioptrics and on halos, and his construction of refracting telescopes of immense size, would have given him the highest reputation. His treatise on dioptrics, which was not published till 1703, among his posthumous works, and which he had begun to prepare at an early period of his life, was particularly admired by Sir Isaac Newton. It contains a copious explanation of the properties of lenses of all forms; and their spherical aberration is treated with much perspicuity, having previously, in the 6th chapter of his *Traité de la Lumière*, published an interesting discussion respecting the figures of transparent bodies for refracting and reflecting light to a single focus. The subject of vision, and the method of assisting long and short-sighted persons by lenses, is ably discussed, and nearly the latter half of the work is devoted to the theory of telescopes, telescopic eye-pieces and microscopes.

Many of these theoretical views Huygens submitted to the test of experiment. Having acquired great expertness in the art of grinding lenses, he executed refracting telescopes 12 and 24 feet in focal length, and afterwards one of 120 and another of 123 feet, with which he discovered Saturn's ring, and the fourth of his satellites. These two last object-glasses he presented to the Royal Society; but as it was impracticable to use tubes of such enormous length, Huygens contrived a method of mounting them without tubes at the top of a long pole. The practical knowledge which he had thus acquired, was published along with his Dioptrics in a work entitled, *Commentarii de formandis poliendisque vitris ad Telescopia*, a considerable part of which was published by Dr. Smith in his optics. Among his posthumous works appeared his *Dissertatio de Cornuis et Parheliis*, a work of great merit, in which he ascribes these phenomena generally to crystals of ice in the upper atmosphere, and a translation of the whole of which Dr. Smith has published in the first volume of his optics.

James Gregory. Born 1638. Died 1675.

Among the eminent men who gave an impulse to optical discovery, we must assign a considerable place to our countryman James Gregory. This eminent mathematician in confirming the experiments of Vitello and Kircher on the angles of refraction, discovered the true law which had previously been found by Snellius. He made the refractive power of water 1·3347, which coincides *exactly* with that of the middle ray between the lines D and E of Fraunhofer. Having discovered before the publication of his work that Descartes' dioptrics contained the law of refraction, he mentions the circumstance, and ascribes his being unacquainted with that work to the "want of new mathematical books," in the library of the college of Aberdeen. Although Baptista Porta appears from the extract which we have already given from his Natural Magic, to have made the nearest possible approach to the invention of the Newtonian reflecting telescope, or rather microscope, yet his experiment excited no notice, and no instrument could be said to have been invented. James Gregory, however, has described what is now known by the name of the Gregorian Reflecting Telescope, at the end of his *Optica Pranata*, published in 1663. It consisted of a parabolic concave mirror perforated at the centre, and having in front of it a small concave elliptic speculum, at a distance a little greater than the sum of their focal lengths. The parallel rays emitted by a remote object formed an image of that object in front of the great mirror, and in its focus; and in the conjugate focus of the small speculum, behind the great speculum, there was formed another image of the object, which was magnified by an eye glass. In 1664, Messrs Rives and Co. English opticians, attempted to construct a six foot Gregorian telescope, under the superintendence of its inventor, but, after a rough trial of it, Mr. Gregory, not aware of the nice adjustments which it required, conceived that the figure of the speculum was defective, and, being on the eve of going abroad, he never even made a tube for the mirrors. Stimulated by the failure of his friend, Newton, "altered," as he says, "the design of the instrument," and "placed the eye glass at the end of the tube rather than at the middle;" and, therefore, he was obliged to reflect the rays to a side by an oval plane speculum. Sir Isaac actually constructed one of these instruments with his own hands, and described it in a letter to a friend, dated the 23d February 1668–9. The aperture of the speculum was one inch, its focal length *six* inches, the eye glass, which was a plano-convex lens, about $\frac{2}{13}$ths of an inch in focal length, and the magnifying power 39 times. He considered it as equal to a three or four feet refractor, and it shewed distinctly the four satellites of Jupiter, and the phases of Venus.[2] Encouraged by his success, he completed another telescope in 1671, which was better than the first, and which is preserved in the library of the Royal Society. The next Newtonian reflecting telescope of any importance, was executed by Mr. John Hadley in 1719 or 1720, with a speculum six inches in diameter, and five feet in focal length; but for a long time the Gregorian form was the most popular in England. About 1672 M. Cassegrain substituted a convex speculum for the small concave one of Gregory, which had the advantage of shortening the tube of the telescope without diminishing the power of the instrument.

Other claimants have arisen for the honour of inventing the reflecting telescope. Father Mersenne in a letter to Descartes in 1637, suggested the idea of using concave mirrors in reflecting telescopes; but Descartes endeavoured to convince him that his views were not likely to succeed. At a later period Fontenelle, in the *History of the Academy of Sciences*, for 1700, has very recklessly ascribed the invention of this instrument to Father Zucchi, an Italian jesuit, who published, at Lyons in 1652, a volume, entitled, *Optica Philosophica*. In this work he says, that he thought of substituting concave specula for object glasses, and having

[1] *Traité* &c. § 20, 21. "Cette double refraction sembloit demander une double émanation d'ondes de lumière, *toutes deux sphériques*, (car les deux refractions sont regulières) et les unes seulement un peu plus lentes que les autres."

[2] Brewster's *Life of Sir Isaac Newton*, p. 26, 27

found a concave metallic mirror in a cabinet of curiosities, he applied to it a concave eye glass, and observed with it celestial and terrestrial objects. As no small speculum was used in this combination, it was neither a Newtonian, Gregorian, nor Cassegrainian telescope; and if Zucchi conceived himself the inventor of a reflecting telescope, why did he conceal it till 1652, and why did he not get a real speculum made to give his idea a fair trial.

Grimaldi discovers the inflexion of light. Born 1619. Died 1663.

Among the discoveries of the 17th century, that of the inflexion of light ranks among the most important. This addition to physical optics was made by Francis Maria Grimaldi, an Italian jesuit, who published an account of it in a work entitled, *Physico-mathesis de Lumine, Coloribus et Iride, aliisque annexis*, which was published at Bologna in 1665, two years after his death. Introducing a ray of the sun's light into a dark room, and through a very small aperture, he remarked, that it formed a cone of light in which all bodies had their shadows larger than if the rays passed in straight lines by their edges. Round these shadows he noticed three coloured fringes becoming narrower as they were farther from the body, and in strong light he observed similar coloured fringes, varying from two to four, according to the distance of the shadow from the body. Hence our author concluded that light is bent from its rectilineal path in passing by the edges of bodies.

When he admitted the light through two small apertures, so near each other that the one luminous cone did not penetrate the other till at a considerable distance from the apertures, he observed that the rays so interfered with one another, as to render the spot illuminated by their *united light more obscure than when it was illuminated by either of them singly.* This extraordinary result is announced in the following proposition: "That a body actually illuminated, may become more obscure by adding a new light to that which it already receives," and may be regarded as the first discovery of the interference of light.

Dr. Hooke. Born 1635. Died 1703.

Dr. Robert Hooke, one of the most ingenious and able men of the century which he adorned, not knowing of the discovery of Grimaldi, communicated to the Royal Society in 1672, an account of "the discovery of a new property of light not mentioned by any optical writers before him." In a subsequent communication in 1675, he draws the following conclusions from his experiments:—1. There is a *deflection* of light, differing both from reflexion and refraction, and seeming to depend on the unequal density of the constituent parts of the ray, whereby the light is dispersed from the place of condensation, and rarified, or gradually diverged into a quadrant. 2. This deflection is made towards the superficies of the opaque body perpendicularly. 3. Those parts of the diverged radiations, which are deflected by the greatest angle from the straight or direct radiation, are the faintest, and those that are deflected by the least angles are the strongest. 4. Rays cutting each other in one common foramen, do not make the angles at the vertex equal. 5. Colours may be made without refraction. 6. The diameter of the sun cannot be taken with common sights. 7. The same rays of light, falling upon the same point of an object, will turn into all sorts of colours by the various inclination of the object. 8. Colours begin to appear when two pulses of light are blended so well, and so near together, that the sense takes them for one."

We owe, also, to Dr. Hooke the first accurate experiments that were made on the subject of thin plates, which, we believe, had been first observed by Mr. Boyle.[1] He investigated the leading phenomena as exhibited in the colours of the soap bubble, and between two plates of glass pressed together. He discovered that the colours depended upon certain thicknesses of the thin plates, but he failed in determining the relation between given thicknesses and given colours. He succeeded in splitting mica into plates of extreme tenuity, as to give the most brilliant colours, one giving a *yellow*, another a *blue*, and the two together a *deep purple.* In his *Micrographia*, printed about seven years before any of Newton's experiments were made on the same subject, Dr. Hooke has published the following remarkable explanation of these phenomena, which coincides in a singular manner, with that which is now universally received: "It is most evident, says he, that the reflection from the under or further side of the body, is the principal cause of the production of these colours. Let the ray fall obliquely on the thin plate, part thereof is reflected back by the first superficies,—part refracted to the second surface, whence it is reflected and refracted again. So that, after two refractions and one reflection, there is propagated a kind of fainter ray, and by reason of the time spent in passing and repassing, this fainter pulse comes behind the former reflected pulse; so that hereby, (the surfaces being so near together that the eye cannot discriminate them from one) this confused or duplicated pulse, whose strongest part precedes, and whose weakest follows, does produce on the retina the sensation of a yellow. If these surfaces are further removed asunder, the weaker pulse may become coincident with the reflection of the second, or next following pulse, from the first surface, and lagg behind that also, and be coincident with the third, fourth, fifth, sixth, seventh, or eighth; so that, if there be a thin transparent body, that from the greatest thinness requisite to produce colours, does by degrees grow to the greatest thickness,—the colours shall be so often repeated, as the weaker pulse does lose paces with its primary or first pulse, and is coincident with a subsequent pulse. And this, as it is coincident, or follows from the first hypothesis I took of colours, so upon experiment have I found it in multitudes of instances that seem to prove it."

Galileo, and the philosophers of the Accademia del Cimento, had proposed to measure the velocity of light by means of a base on the surface of the globe; but such an attempt was utterly hopeless, and it was only in a wider range that this problem could be solved. Baffled in finding an explanation of some irregularity in the emersion of the first satellite of Jupiter, Cassini and Roemer had concluded that it depended on the distance of Jupiter from the earth, and that in order to explain it it was necessary to suppose, that the light of the satellite required ten or eleven minutes to move across the earth's orbit. This happy idea seems to have first occurred to Cassini, but he speedily abandoned it, while Roemer pertinaciously cherished the hypothesis, and at last immortalised himself by demonstrating in the most rigorous manner that light moves through the diameter of the earth's orbit, a distance of 190 millions of miles, in eleven minutes.

Roemer. Born 1644. Died 1710.

Passing over the valuable researches of Tschirnhausen, a Saxon nobleman, on caustic curves, which had been previously discovered, and the discoveries of Mariotte and de la Hiré, respecting the seat of vision, which have not terminated in any satisfactory conclusions, we are brought to one of the most brilliant periods of optical discovery.

Discoveries of Newton. Born 1642. Died 1727.

In the year 1665, Sir Isaac Newton, when only 23 years of age, bought three prisms, but he does not seem to have made any particular experiments with them. In 1666, however, he bought another, with which he proposed to repeat Grimaldi's experiment, on the elongation of the sun's image produced by the prism. In the course of this and the two or three subsequent years, he made and perfected his great discovery of the *different refrangibility of light*, which he communicated to the Royal Society on the 6th of February 1672, having, on the 18th of January, announced it as "the oddest if not the most considerable detection

[1] *Experiments and Observations upon Colours*, 1663.

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which hath hitherto been made in the operations of nature." Having found that refraction could not be produced without colour, he was led to direct his attention to the perfection of the reflecting telescope, and produced the instruments which we have already mentioned. Another result of this discovery was the completion of the theory of the rainbow, the origin of the colours of which had hitherto perplexed philosophers.

The next optical discovery made by Sir Isaac Newton, related to the *colours of thin plates*, or of thin transparent bodies, such as the soap bubble. We have already seen that Dr. Hooke had made some progress, both in observing the phenomena and in investigating the cause of such colours; but it is to Newton that we owe an elaborate analysis of the subject. In a letter from Sir Isaac to Dr. Hooke, dated 5th February 1676, he acknowledges that the latter had previously observed "the dilatation of the coloured rays by the obliquation of the eye, and the opposition of a black spot at the contact of two convex glasses, and at the top of a water bubble," (soap bubble). In the course of his experiments on thin plates, Newton was led to the discovery of the colours of thick plates, and he devised a theory for explaining both classes of phenomena, known by the name of the theory of fits of easy reflexion and transmission. This theory, remarkable for its ingenuity, is now no longer an expression of the phenomena, and has given way to the theory of undulations, which Hooke had the sagacity to anticipate as affording the true cause of the colours of thin plates.

Early in 1676, Newton communicated to the Royal Society his *Theory of the Colours of Natural Bodies*, in which he ascribes all the varieties of colour exhibited in nature to the circumstance "that the transparent parts of bodies, according to their several sizes, reflect rays of one colour and transmit those of another, on the same grounds that thin plates or bubbles do reflect or transmit those rays." This theory, perhaps the finest of all Newton's optical speculations, has met with much opposition. It was controverted by Mr. Delaval, Sir John Herschel, and others, in its leading propositions; but some recent discoveries afford us reason for believing that the principal objections to it are groundless, and that with some modifications it may yet be placed among the finest generalizations in science.

Sir Isaac Newton's experiments on the inflexion of light were never finished by their author. His observations were limited, and his theory incorrect; and indeed it was only from the hands of those who adopted the undulating system that a true explanation of the phenomena could be expected.

The experiments of our author on the refractive powers of bodies, from which he anticipated that the diamond "was probably an unctuous substance coagulated," have on this account been regarded with high favour, while his few observations on the double refraction and polarisation of light have almost disappeared from the history of optics.[1]

Achromatic telescope.

The next great step in the history of optical discovery is the invention of the *achromatic telescope*, or telescopes which are free from colour. When Sir Isaac Newton found that he could not produce refraction without colour, he abandoned the improvement of the refracting telecide as hopeless, and devoted himself to the construction of reflectors. The opinion at which he had arrived respecting the impracticability of refracting light without colouring it, was, however, an erroneous one, which he had deduced from an incorrect observation of the relative length of the prismatic spectra formed by different bodies, when the mean refraction was the same. In less than two years after Newton's death, namely, in 1729, Mr. Chester More Hall, of More Hall in Essex, was led by the study of the human eye, which he erroneously conceived to be achromatic, to consider the possibility of constructing a telescope by an analogous combination of media. After many experiments, he found two kinds of glass capable of producing, by their combination, refraction without colour.[2] About 1733 he completed several such object-glasses, which, with a focal length of twenty inches, bore an aperture of more than two-and-a-half inches, one of which was long afterwards in the possession of the Rev. Mr. Smith of Charlotte Street, Rathbone Place, and was found to be achromatic. Another of Mr. Hall's telescopes was in the possession of Mr. Ayscough, optician in Ludgate Hill, in 1754. Mr. Hall, however, kept his invention a secret; none of his instruments were either sold or exhibited for sale, and those into whose hands they fell do not seem to have discovered either their principle or their value.

Without calling in question the merits of Mr. Hall, we must do justice to those of Mr. John Dollond, an undoubted inventor of the achromatic telescope, who, unacquainted with the instruments of Mr. Hall, proceeded step by step, in a scientific progression, till he invented and constructed the achromatic telescope in 1757. To this eminent individual, and the other members of his family, we owe the construction of many of the finest instruments by which the science of astronomy has been so much promoted. Mr. Peter Dollond, the son of John Dollond, first suggested and used the triple object-glass, in which a better correction of the spherical aberration was effected, by placing the concave flint glass between two convex lenses of crown glass.

The mathematical world owe many obligations to Euler, Clairaut, D'Alembert, and Boscovich, for their able investigations of the theory of achromatism, but their investigations did not prove of any practical value; and it has been justly stated by Sir John Herschel, "that from all the abstruse researches of Clairaut, Euler, and D'Alembert, and other celebrated geometers, nothing hitherto has resulted beyond a mass of complicated formulas, which, though confessedly exact in theory, have never yet been made the basis of construction for a single good instrument, and remains therefore totally inapplicable, or at least unapplied in practice."[3]

No attempt had hitherto been made to measure the intensity of different lights emanating either directly from luminous bodies, or when transmitted through or reflected from different bodies. This subject, to which the name of Photometry has been given, was begun by Huygens and P. F. Marie, who describes an instrument called a *lucimeter*; but it is to M. Bouguer and M. Lambert that we owe the most scientific and complete investigation of this class of facts.

Bouguer's earliest experiments were published in 1729, in his *Optical Essay on the Gradation of Light*, which was republished in 1760, much augmented and improved, under the title of *Traité d'Optique sur la Gradation de la Lumière*.

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1 We must refer our readers for a full and elaborate account of Newton's optical discoveries to a new work, entitled *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*, in which Sir David Brewster is now occupied, having had access to the interesting collection of the papers of Sir Isaac, in the possession of the Earl of Portsmouth.

2 Mr. Hall might have got this hint from David Gregory's *Catoptrics*, published at Edinburgh in 1713. "But if," says he, "on account of physical difficulties in grinding and polishing proper specula, we should still use lenses, *it would perhaps be useful to employ media of different density to compose the object-glass*, as we see done by nature in the structure of the eye, where the crystalline humour, (of almost the same refractive power as glass), is joined by nature, who does nothing in vain, with the aqueous and vitreous humours, (not unlike water in their refractive power), to paint the image as distinctly as possible in the bottom of the eye." Gregory's *Catoptrics*, prop. xxiv. Scholium. Dr. Brown's translation of the preceding passage is very incorrect.

3 *Phil. Trans.* 1821, p. 222.

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Lambert. Born 1728. Died 1777.

Bouguer was followed in this inquiry by M Lambert, an able German mathematician, who published an account of his researches at Augsburg in 1760, in a duodecimo volume of 547 pages, entitled *Photometria seu de Mensura et Gradibus Luminis, colorum et umbræ.* It is divided into seven parts: 1. On the modifications and degrees of direct light, and of its brightness and illuminating power; 2. Experiments and calculations on the modifications of light depending on transparent bodies, but chiefly glass; 3. Experiments and calculations respecting the modifications of light depending on the opacity of bodies; 4. Calculations and experiments on the sense of light, and its apparent brightness; 5. On the dispersion of light passing through diaphanous media, chiefly the earth's atmosphere; 6. Calculations respecting the illumination of the planetary system; and, 7. On the modifications and degrees of heterogenous and relative light, or the light of colours and shadow.

Sir William Herschel. Born 1738. Died 1822.

Passing over the minor labours of Porterfield, Turner, Mazeas, Dutour, Buffon, Scheiffer, Darwin, Melville, Mitchell, and others we come to the period of Sir William Herschel. Since the discovery of the belts and nearest satellites of Saturn, no discovery of any importance had been made respecting the natural history of the heavens. At the age of 36, when Sir William was residing at Bath, he devoted much of his time to the construction of telescopes; and the following account of his progress is too interesting to be given in any other language than his own,—"When I resided," says he, "at Bath, I had long been acquainted with the theory of optics and mechanism, and wanted only that experience which is so necessary in the practical part of these sciences. This I acquired by degrees at that place, where, in my leisure hours, by way of amusement, I made for myself several two feet, five feet, seven feet, ten feet, and twenty feet Newtonian telescopes, besides others of the Gregorian form, of eight inches, twelve inches, two feet, three feet, five feet, and ten feet, focal length. My way of doing these instruments at that time, when the direct method of giving the figure of any one of the conic sections to specula was still unknown to me, was to have many mirrors of each sort cast, and to finish them all as well as I could, then to select by trial the best of them, which I preserved; the rest were put by to be re-polished. In this manner, I made no less than two hundred seven-feet, one hundred and fifty ten-feet, and about eighty twenty-feet, not to mention those of the Gregorian form, or of the construction of Dr. Smith's reflecting microscope, of which I also made a great number. My mechanical amusements went hand in hand with the optical ones. The number of stands I invented for these telescopes it would not be easy to assign. I contrived and delineated them of different forms, and executed the most promising of the designs. To these labours we owe my seven-feet Newtonian telescope stand, which was brought to its present convenient construction about 1778."

By means of these instruments, with which he surveyed the heavens with unwearied diligence, he discovered the Georgium Sidus, with six satellites, two new satellites circulating round Saturn, the quintuple belt and double ring of the same planet, and various other astronomical phenomena of the highest interest. In 1783 he finished a twenty-feet reflector, with an aperture of $18\frac{7}{10}$ inches, and formed the design of constructing a still larger instrument. On the recommendation of Sir Joseph Banks, his Majesty George III. agreed to defray the expense of a large telescope, and under his munificent patronage, which has never since been imitated by his successors, Sir William began in 1785, and completed on the 27th August 1789, a reflecting telescope forty feet in focal length, having its great speculum *four feet* in breadth three-and-a-half inches thick, and weighing, when newly cast, 2118 pounds. On the 28th of August, the day after this gigantic instrument was erected, Sir William discovered a new satellite of Saturn, and in the same year another satellite, both of which were nearer the body of the planet than the other five discovered by Huygens and Cassini. In this manner the telescope, which was a toy in the hands of Galileo, became with Sir William Herschel a vast machine, carrying the observer himself, and directed and moved by appropriate mechanism.

Dr. Blair. A.D. 1787. Died 1829.

An improvement in the achromatic telescope, of great value, though not yet brought into practical use, was made by Dr. Robert Blair. Although in the achromatic telescope composed of crown and flint glass, the colour was as completely corrected as it was possible to do with such lenses, yet it had long been observed that there were residual colours, which formed what are called a secondary spectrum, and which arise from the coloured spaces in the spectrum, produced by crown glass not having the same size as those in a spectrum of equal length produced by flint glass. Various attempts had been made in vain to obtain other substances, in which this *irrationality*, as it was called, of the coloured spaces did not exist; and Dr. Blair was hence led to attempt the removal of the secondary spectrum by other means. The plan which he adopted was the following. He made each lens of his compound object-glass achromatic, but in such a way that the secondary spectrum produced by the one should be corrected by the secondary spectrum produced by the other. Such an object-glass required two fluid media and three lenses of glass, and Dr. Blair succeeded in constructing them so as to be perfectly free from all secondary colour. In the course of his experiments, however, he was fortunate enough to discover that the muriatic acid mixed in proper proportions with metallic antimony, or butter of antimony, as it was called, gave a spectrum, in which the colours had exactly the same proportion as crown glass; and hence, by enclosing this fluid between two lenses of crown glass, the one next the object being plano-convex and the other a meniscus, he obtained an object-glass in which the rays of different colours were bent from their rectilineal course with the same equality and regularity as in reflexions. To such an object-glass he proposed to give the name of *aplanatic*, to indicate the entire removal of all aberration. Dr. Robison informs us that one of these telescopes, which did not exceed *fifteen inches* in length, equalled in all respects, if it did not surpass, the best of Dollond's achromatic telescopes *forty-two inches* long. After the death of Dr. Blair, his son, Mr. Archibald Blair, attempted in vain to produce instruments of the same perfection. Had this young man lived, he might have executed something better, but he was cut off at an early age, and has left to the Royal Society of Edinburgh an account of his father's methods, which we hope may prove useful to science.

Dr. Thomas Young. Born 1773. Died 1829.

Hitherto the undulatory theory of light as proposed by Huygens and supported by Hooke and Euler, had met with few adherents; and the reputation of Newton had given to the theory of emission an adventitious authority to which it was not entitled. Dr. Young, however, boldly threw down the gauntlet and maintained the theory of Huygens with the greatest ingenuity and talent. In his paper of 1800, entitled *Outlines of Experiments and Observations on Sound and Light*, he shews that light has a strong analogy with sound, and that it is produced by the undulation of a highly elastic etherial medium which pervades all nature. In another paper, which he published in 1801, *On the Theory of Light and Colours*, he applies the theory of undulations to the explanation of natural phenomena; and lays down the following hypotheses: 1. That a luminiferous ether pervades the universe, rare and elastic in a high degree. 2. That undulations are excited in this ether whenever a body becomes luminous. 3. That the sensation of different colours depends on the different frequency of vibrations excited by light in the retina; and, 4th, that all material bodies are to be considered, with respect to the phenomena of light, as consisting of particles so remote from each other as to allow the

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etherial medium to pervade them with perfect freedom, and either to retain it in a state of greater density and of equal elasticity, or to constitute together with the medium an aggregate which may be considered as denser but not more elastic. He then proceeds to demonstrate in nine propositions, some of the leading truths in the theory, applying them in corollaries to the colour of striated surfaces, the colours of thin plates, the colours of thick plates, and the colours produced by inflexion. In 1802, Dr. Young published *An account of some causes of the Production of Colours not hitherto observed.* The cases described in this paper are the colours of delicate fibres and of mixed plates. The first he explains by the interference of two portions of light, one reflected from the fibre and the other bending round its opposite side, and at last coinciding nearly in direction with the former portion. The colours of mixed plates are those produced when moisture, butter, or tallow, are placed between two plates of glass, so that portions of air are intermixed with these substances. A candle seen through such a medium is surrounded with a sort of halo, and Dr. Young considers the colours as produced by the light which passes through one of the media, moving with greater velocity so as to anticipate the light which comes more slowly through the other.

In 1803, Dr. Young published what may be considered as his principal paper, entitled *Experiments and Calculations relating to Physical Optics*, in which he has given an experimental demonstration of the general law of interference. By intercepting the rays which passed on one side of a body which formed fringes by reflexion, the fringes disappeared whether the interception was made on one side or the other of the body. This admirable experiment established the truth of his law of interference, and paved the way for those splendid generalizations respecting the undulatory theory which have so widely enlarged the boundaries of optics.

In April 1814, in a review of Malus, Biot, and Brewster's *Experiments on Light*, which he contributed to the *Quarterly Review*, he first published his explanation of the colours of crystallised plates produced by polarised light by the law of interference, an explanation which is now universally admitted. In the article on *Chromatics*, which Dr. Young contributed to this work, the reader will find a full account of the discoveries to which the law of interference has been so successfully applied. One of the most important applications of the undulatory theory was published in that article for the first time. Dr. Young has there given an expression of the velocity of reflected light at a perpendicular incidence from bodies of various refractive powers, which is a simple function of the index of refraction.

In giving an account of Sir William Herschel's discoveries, we have not mentioned his discovery of invisible heating rays beyond the red extremity of the spectrum, because we have ourselves succeeded in discovering the luminous rays at that part of the spectrum. In repeating Sir W. Herschel's experiments, M. Ritter of Jena placed muriate of silver in different parts of the spectrum, and found that it soon became black *beyond* the violet extremity, less black in the violet rays, becoming still less black in the blue and green, and so on till the blackness vanished. When he used muriate of silver, slightly blackened or disoxygenated, its white or original colour was partly retained by the red, and still more by the supposed invisible rays beyond it. In these experiments of Ritter's, as well as in those of Sir W. Herschel, the solar spectrum, when seen by the eye, as thrown upon paper, is extremely short. A great part of the violet extremity as well as the red extremity is invisible, so that when the thermometer and the muriate of silver seemed to be wholly out of the spectrum, they were completely within the violet and the red spaces, as we have placed beyond a doubt by

Ritter, A.D. 1801.

comparing the length of a spectrum on paper with that which can be rendered visible by directly looking through a telescope at a highly magnified one.

Histo[ry]

Dr. W[ol]laston. Born [...] Died [...]

Without knowing of the experiments of Ritter, Dr. Wollaston discovered the chemical effects which exist at the violet end of the spectrum; but the merit of this experiment decidedly belongs to Scheele, who discovered that muriate of silver was more blackened in the violet rays than in any other part of the spectrum. The principal discovery in optics, which we owe to Dr. Wollaston is his method of observing the spectrum, and his discovery of *five* fixed lines in it. The following is his own description of it: "I cannot conclude these observations on dispersion without remarking that the colours into which a beam of white light is separable by refraction, appear to me to be neither seven, as they usually are seen in the rainbow, nor reducible by any means (that I can find) to three, as some persons have conceived; but that, by employing a very narrow pencil of light, four primary divisions of the prismatic spectrum may be seen with a degree of distinctness that, I believe, has not been described nor observed before.

"If a beam of day-light be admitted into a dark room by a crevice $\frac{1}{20}$ of an inch broad, and received by the eye at a distance of ten or twelve feet, through a prism of flint glass *free from veins*, held near the eye, the beam is seen to be separated into the four following colours only, red, yellowish green, blue, and violet; in the proportion represented in the figure.

"The line A that bounds the red side of the spectrum is somewhat confused, which seems, in part owing to the want of power in the eye to converge red light. The line B, between red and green, in a certain position of the prism, is perfectly distinct; so also are D and E, the two limits of violet. But C, the limit of green and blue, is not so clearly marked as the red; and there are also, on each side of this limit, other distinct dark lines, *f* and *g*, either of which in an imperfect experiment, might be mistaken for the boundary of these colours.

"The position of the prism in which the colours are most clearly divided is when the incident light makes about equal angles with two of its sides. I thus found that the spaces AB, BC, CD, DE, occupied by them, were nearly as the numbers 16, 23, 36, 25.

"Since the proportions of these colours to each other have been supposed by Dr. Blair to vary according to the medium by which they are produced. I have compared with this appearance the coloured images caused by prismatic vessels, containing substances supposed by him to differ most in this respect, such as strong but colourless nitric acid, rectified oil of turpentine, very pale oil of sassafras, and Canada balsam also nearly colourless. With each of these I have found the same arrangement of the four colours, and, in similar positions of the prisms, as nearly as I could judge, the same proportions of them.[1]

"But, when the inclination of any prism is altered so as to increase the dispersion of the colours, the proportions of them to each other are thus also changed, so that the spaces AC and CE, instead of being as before 39 and 61, may be found altered as far as 42 and 58." These interesting observations are appended to his *Method of examining Refractive and Dispersive Powers by Prismatic Reflection*, which was published in the *Phil. Trans.* for 1802.

In the year 1800, Dr. Wollaston published in the *Philosophical Transactions* some interesting experiments and observations *On Double Images caused by Atmospherical Refraction*, and in the same work for 1802, he communicated a series of measures *On the Oblique Refraction of Iceland Crystal* in different planes, which he found, as the measures taken by Huygens had done before,

[1] The observations in this paragraph are quite incorrect. Dr. Blair's results to which they stand opposed have been placed beyond the reach of doubt.

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to agree in a remarkable manner with the beautiful law established by the Dutch philosopher.

These researches of Dr. Wollaston, but particularly the discoveries of Dr. Young, had about this time drawn the attention of the philosophers of France to the subject of double refraction. Laplace had considered the deviation of the extraordinary ray, as due to the action of the attractive and repulsive forces by which Newton and his successors had endeavoured to explain the ordinary refraction and reflexion of light; and the Institute of France were thus led in 1808 to propose the double refraction of light as the subject of a prize to be adjudged in 1810. Among the few memoirs which were sent in competition for this prize, that of E. L. Malus, colonel of the imperial corps of engineers was the successful one. After his return from the fatal expedition to Egypt he had composed his *Traité d'Optique*, a work of great merit; but as soon as the subject of double refraction was announced, he devoted himself to the inquiry with equal ardour and success. Residing in the Rue des Enfers, in Paris, he happened to view, through a doubly refracting prism, the windows of the palace of the Luxembourg, which were then reflecting to his eye the rays of the setting sun, and, on happening to turn round the prism, he was surprised to perceive that one of the two images of each window vanished in every quadrant of the rotation of the prism. In pursuing this remarkable experiment he was conducted to the splendid discovery which forms an epoch in the history of optics, *that when a pencil of light is reflected by a surface of glass at an angle of 54° 35′, or of water at an angle of 52° 45′, the reflected light possesses all the characters of one of the pencils formed by double refraction.* Hence the pencil was said to be *polarised* by reflexion. When a pencil thus reflected was made to fall on another surface of the same kind at the same angle, but so that the plane of the second reflexion was at right angles to the plane of the first, then not a single ray of the light suffered reflexion, the whole pencil suffering refraction only. When the light fell upon a plate of glass the light reflected from the second surface acquired the same property.

Malus. Born 1775. Died 1812.

On the 11th of March 1811, Malus announced to the Institute, that, when a pencil of light was thus polarised by reflexion, the light which was at the same time transmitted through the surface consisted of a portion of light polarised in an opposite direction, and proportional to that which was reflected, and of another portion not modified, which preserves the properties of direct light. This last portion becomes less and less by transmitting the ray through a number of plates in succession till the transmitted pencil is wholly polarised in one direction.

Malus likewise made several experiments on the polarisation of light by metals, and he was led to the conclusion, that the difference between transparent and metallic bodies was, that the former refract all the light polarised in one direction, and reflect all that is polarised in the other, while metallic bodies reflect what they polarise in both directions.

In a series of experiments on crystals and organised substances, communicated to the Institute on the 19th August 1811, Malus found that they all *depolarised* a pencil of polarised light; that is, a pencil of polarised light which refused to be reflected by another surface properly placed, recovered its power of being reflected after being transmitted through crystals and organised substances. All crystals which did not crystallise in the form of the cube or the regular octohedron were found to possess the property of depolarisation; and the organised substances which he found to possess the same property, were the transparent and fibrous portions of leaves and flowers, the pellicles which cover the hazel, silken and woollen fibres, white hairs, scales, horn, ivory, feathers, the skins of quadrupeds and fishes, shells, and the whiskers of a whale. Malus intended to prosecute this subject to a greater extent, but his brilliant career of discovery terminated by his death on the 7th February 1812.

Discoveries of M. Arago. Born 1786.

The loss of Malus, great as it was felt to be, was immediately supplied by his distinguished colleague in the Institute, M. Arago, who has added to this and other departments of science so many brilliant discoveries. On the 11th of August 1811, before the death of Malus, M. Arago communicated to the Institute a memoir "On a particular modification which the luminous rays experience in their passage through certain transparent bodies."[1] Upon exposing thin plates of sulphate of lime, mica, and rock-crystal, to polarised light, and subsequently analyzing the light which they transmitted by a prism of calcareous spar, M. Arago observed the most splendid complementary colours changing with every variation in the inclination of the plate. When the light was incident perpendicularly, and the plate turned round in its own plane, the colours were in all positions the same, though they varied in intensity. He found two positions at right angles to each other, in which the crystal gave no colour, and these positions were those in which the principal section of the crystal was perpendicular to, or coincident with the plane of primitive polarisation. Setting out from these positions, the intensity of the ray gradually increased, and became a maximum at an angle of 45° to that plane. When the crystallised plate was fixed, and the analysing plate turned round so as to vary the inclination of the plane of reflexion from it, to that of the fixed plate which polarised the light primitively, the change in the colours was most beautiful. M. Arago observed that the colour reflected in any one position of the analysing plate was *complementary* to the colour reflected in the perpendicular position. He also found that the power of depolarising the different colours diminished with the thickness of the plate, and he reduced mica to such a degree of thinness that it depolarised no colours at all. In studying the same phenomena in sulphate of lime and rock crystal, M. Arago was led to the conclusion that the colours depended on some other cause than that of the thinness of the plate. M. Arago likewise discovered the depolarising property in a piece of flint glass, about three quarters of an inch in thickness.

We owe also to M. Arago the discovery of circular polarisation in quartz, which he made in 1811. By transmitting polarised light along the axis of the prism he observed the tints to be different in their nature from the ordinary tints of the mineral, although they increased and diminished with the thickness of the plate. When analysed with a prism of Iceland spar, he observed that the true images had complementary colours as in the ordinary tints, and that the colours changed, descending in Newton's scale as the prism was turned round, so that if the colour of the extraordinary image was *red*, it became in succession *orange yellow, green*, and *violet*; and hence he drew the important inference that the differently coloured rays had been polarised in different planes in passing along the axis of the crystal. M. Arago's duties in the Observatory prevented him from pursuing these valuable discoveries with that continuity of labour which they demanded.

A very important discovery was made by M. Arago respecting the colours of thin plates.[2] When the rings of thin plates were examined through a rhomb of Iceland spar, M. Arago discovered that when the principal section of the rhomb was parallel and perpendicular to the plane of incidence, the intensity of the light in one of the images varied with the incidence, and that this image vanished altogether when the pencil of light was inclined 35° to the surface, or when it was incident at the maximum polarising angle. This result was the same, whether he examined the reflect-

[1] Mémoires de l'Institut 1811, part i. p. 93–134.

[2] Mémoires d'Arcuel, tom. iii. *Sur les Couleurs des Lames Minces.*

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ed or the transmitted rings. Hence he inferred that the light of both the systems of rings was polarised in the plane of incidence, at the polarising angle for glass. M. Arago has likewise shewn that the colours of the reflected and transmitted rays are complementary, and that their intensities are exactly equal, completely neutralising each other or forming white light when they are superposed. The most interesting experiment, however, made by M. Arago, is that in which he examined the rings when a convex lens was pressed upon a metallic reflector. When viewed with a prism of Iceland spar, as before, one of the two images vanished at the maximum polarising angle of the glass, but the phenomena were different above and below this angle. At less angles, the dimensions and the colours of the rings were the same in both images, which differed only in the quantity of their light; but at greater angles, the rings in the two images had their colours complementary, the one beginning from a white centre, and the other from a black one.

We have already seen that Dr. Young first applied the principle of interference to explain the colours of crystallised plates; but he did not explain why these colours are not produced excepting with polarised light. MM. Arago and Fresnel entered upon this inquiry, and obtained a satisfactory solution of the difficulty. They found that two rays of light polarised in the same plane, produced fringes by their interference as in common light; that no interference at all takes place when these planes are at right angles to each other: and that at an intermediate inclination, the interference is diminished, and the fringes decrease in intensity. In following out these interesting results, they found that two oppositely polarised pencils will not interfere even when their planes are made to coincide, unless they belong to a pencil which had been wholly polarised in one plane.

We owe also to M. Arago the beautiful discovery that the quantity of polarised light in the reflected and transmitted pencils of common plates are exactly equal.

We are indebted likewise to M. Arago for some important results respecting the interference of light. We have already seen that the interior fringes formed by diffraction disappear when the light which passes by one side of the inflecting body is stopped. M. Arago observed that these fringes were displaced by making the same light pass through a thin plate of some transparent substance, and that the bands were always shifted to the side on which the plate was placed. The amount of this displacement determines the velocity of light in the interposed medium, and consequently gives us a measure of the refractive power of that body with the highest degree of accuracy.

In conjunction with M. Biot, M. Arago published a valuable series of experiments on the density and refractive power of *nine* gaseous bodies measured in relation to atmospheric air taken as unity. Hydrogen stood at the head of the table, with a refractive index equal to 6·61436, (or 7·0335 if we use the density given by Berzelius) whilst oxygen stood at the foot of the table with a refractive index of 0.8616.

M. Biot. Born 1774.

Among the most successful cultivators of physical optics, M. Biot holds a distinguished place. His attention was first directed to the colours of crystalline plates discovered by M. Arago, and by nice instruments and indefatigable labour he determined the general laws of the phenomenon in reference to the thickness of the plates, and the composition of the tints as observed in sulphate of lime and rock crystal, calcareous spar, and arragonite. He observed that at a perpendicular incidence the two colours correspond to those seen by reflexion and transmission in thin plates of air, and he concluded that the thicknesses at which these colours were developed, were proportional to the thickness of the plate of air which gave the same tint in Newton's scale. These thicknesses were found to vary with the nature of the crystal, and were always much greater than the thicknesses of thin plates which gave the same tints. He had at first supposed that at oblique incidences the changes of colour followed the same law as in thin plates, but he afterwards found that the tint depended on the thickness of the crystal traversed by the refracted ray, and as the square of the sine of the angle which the direction of the ray formed with the optic axis. In these experiments M. Biot considered arragonite, sulphate of lime, topaz, and mica, as all having one axis of double refraction like calcareous spar.

In order to explain these various phenomena, M. Biot communicated to the Institute in 1812[1] his ingenious theory of *Moveable Polarisation*. In this theory the particles of a polarised ray are supposed to preserve their primitive polarisation till they reach a certain depth in the crystal, when a succession of isochronous oscillations round their centre of gravity take place, the axes of polarisation being carried alternately to each side of the axis of the crystal. The depth through which the particle is carried during each of these oscillations, is assumed to be twice the depth through which it has passed before the oscillations began. When the ray emerges from the crystalline plate, the oscillations are supposed to stop, and the ray assumes a *fixed polarisation*, (in which the axes of the particles are arranged in two rectangular directions) as if the last oscillation had been completed when it quitted the plate.

The remarkable colours discovered by M. Arago along the axis of quartz, were carefully studied by M. Biot, and he and M. Seebeck, nearly about the same time discovered the existence of the very same colours in several essential oils and solutions, such as oil of turpentine, oil of laurel, oil of lemons, syrup of sugar, the two first turning the planes of polarisation from right to left, and the two last from left to right. In a memoir laid before the Institute in 1818, he has shewn that the angular rotation of the plane of polarisation is directly proportional to the thickness of the plate and inversely to the square of the length of the fits as given by Newton. He then concludes that this property of turning the particles of light round their centres of gravity resides in the ultimate particles of solid or fluid bodies, that it is necessary to their very existence, and that it is entirely independent of their mutual distances and mode of aggregation.

M. Biot afterwards resumed this subject, and extended his researches to a great variety of substances; and he has still more recently employed circular polarisation in detecting the constituents of particular vegetable substances, where chemical analysis had partly or wholly failed. He has shewn that the soluble portion of plants, or the farinaceous matter of grain and roots, to which he has given the name of *dextrine*, and which M. Raspail had considered to be of the nature of gum, turns the planes of polarisation more powerfully to the *right* (hence the name *dextrine)* than the syrups of *cane sugar;* and that all the *gums*, and the syrups of the *sugar of grapes*, turn the planes of polarisation to the left. M. Biot has also applied the same method of research in ascertaining the changes which take place in the sap of trees, and in analysing the processes of vegetation which are concerned in the growth of wheat and rye. His researches are of great practical value in an agricultural point of view, and ought to impress on those whom it most concerns, the important truth, that the most recondite discoveries in science will sooner or later find an useful application.

One of the most important discoveries made by M. Biot was the true nature of the double refraction and polarisation in quartz, which Huygens had been unable to develope. M.

[1] *Sur un nouveau genre d'Oscillation que les Molecules de la Lumière eprouvent en traversant certains cristaux.*

Biot found that it differed from that of calcareous spar, in having the phenomena regulated by a *prolate* in place of an *oblate* spheroid, the least refracted image being the ordinary ray in quartz, and the extraordinary one in Iceland spar.

Sir David Brewster.

Whilst these valuable researches were carrying on in France, Sir David Brewster was occupied with the same subject in Scotland. In his *Treatise on New Philosophical Instruments*, published in the beginning of 1813, he has shewn that chromate of lead and realgar exceed the diamond[1] in refractive power; that diamond, phosphorus, and sulphur have their high refractive powers in the order of their inflammabilities; that fluor spar and cryolite have their refractive powers below all solid substances, (excepting *tabasheer)*, and lower dispersive powers than all other bodies; and that all doubly refracting crystals have a double dispersive power. He shewed that oil of cassia had the least, and sulphuric acid the greatest action upon green light; that a tertiary spectrum is formed, when prisms of the same substance but different angles are made to correct the dispersion, by the inclination of one of them; and that achromatic combinations may be effected by prisms and lenses of the same kind of glass.

In the year 1812, he began to study the subject of the polarisation of light, in consequence of having become acquainted with Malus's celebrated discovery of the polarisation of light by reflexion. He discovered the remarkable property of the agate, by which it gives only a single distinct image polarised in one plane; the property of depolarisation possessed by almost all minerals, and by many animal and vegetable substances;[2] the polarised colours produced by thin plates of mica and topaz; the partial polarisation of light by polished metals;[3] and the complete polarisation of the exterior and interior rainbows.

In the course of these inquiries our author discovered the two beautiful systems of elliptical coloured rings, which we see by transmitting polarised light along the two optical axes of topaz; and in consequence of his using a conical in place of a parallel beam of light in these experiments, he was led to observe the same system of rings, under different modifications, in various other bodies. While examining the depolarising effect of a plate of mica at an oblique incidence, he was led to the discovery of the polarisation of light by oblique transmission through bundles of crystallised or uncrystallised plates; and though Malus had anticipated him in this discovery, yet he had determined the law of the phenomena, which had escaped the notice of that skilful observer.

Hitherto no idea had been formed of the mechanical condition of bodies in which the polarising and doubly refracting structure were exhibited; but in the years 1814 and 1815, a new light was thrown upon the subject, by three discoveries made by Sir David Brewster, namely, that the polarising structure could be produced in glass by heat, and also by rapid cooling;[4] that Prince Rupert's glass drops, formed by rapid cooling, possessed that structure;[5] and that *by means of simple pressure, that species of crystallisation could be communicated to soft and indurated jellies, which forms two apparently polarised images, and exhibits the complementary colours by polarised light.*[6]

We have already seen that Malus considered the property of polarisation by reflexion as independent of the other modes of action which bodies exercise upon light. In order to investigate this subject, Sir David Brewster made an extensive series of experiments to determine the angles of maximum polarisation by reflexion, from the surfaces of bodies, and from the separating surfaces of different media. After encountering many difficulties, he was led to the discovery of the very simple law *that the index of refraction is the tangent of the angle of polarisation*, which is rigorously true for all separating surfaces, and for rays of all refrangibilities; and hence we obtain an immediate explanation of the perplexing fact, that at the maximum polarising angle the polarisation of the ray is never complete. When this law is expressed geometrically, it informs us that when a ray of light is polarised by reflexion, the reflected ray forms a right angle with the refracted ray; that the sum of the angles of reflexion and refraction is a right angle, or counting from the surface, that the angles of reflexion and refraction are equal. In the same paper, our author has shewn that light may be completely polarised by two, three, or more reflexions, at angles all above or all below, or partly above and partly below the angle of complete polarisation, a greater number of reflexions being required, as the incident ray approaches either to the refracting surface, or to a line perpendicular to it. In the same paper, it is shewn that every ray of light polarised by reflexion has been acted upon by the refracting force; and that total reflexion exercises an analogous action upon light with metallic surfaces.

The influence of heat in producing a transient polarising structure in glass, led our author to an elaborate examination of the subject in 1815.[7] When the edge of a thick plate of glass is laid on a bar of hot iron, the heat gradually propagates itself along the plate, and its path is marked by the most beautiful fringes of polarised light; but no sooner has the heat entered the plate of glass, than similar fringes appear on its upper edge, *where there is no heat at all.* After a certain period, the whole surface of the glass is covered with coloured fringes, which are arranged in two similar polarising structures at the edges, separated by two dark lines or axes from an opposite structure in the middle. When the glass is removed from the iron, the fringes gradually disappear, and are extinguished when the heat is uniformly diffused over the glass. If the plate of glass is made very hot in boiling oil, and is then allowed to cool with its edges against a plate of cold iron, it will exhibit in a fainter degree the fringes above described; but they are now all reversed, the middle structure having the same character as the external structures had formerly, and *vice versa.* If, when a plate of glass is covered over with the polarised tints, it is suddenly cut in two by a diamond in the direction of its length, the whole structure is instantly changed, and each piece has the same properties and structure as the whole, exactly like a portion detached from the end of a magnet. The same properties he found in muriate of soda, fluor spar, obsidian, semi-opal, horn, tortoise-shell, and various animal and vegetable bodies. The tints thus developed by heat exhibit, by their being made to cross one another and by other modifications, a series of the most brilliant phenomena within the whole range of optics.

In continuing these experiments, our author found that when the plate of glass, after being brought to a red heat, was allowed to cool quickly, it exhibited permanently the same coloured fringes, a discovery which had likewise been made by Dr. Seebeck of Nuremberg.

This paper is followed by another, published in the same

[1] In all tables of refractive powers of solids and fluids, *diamond* stood at the head, and *water* and *ice* at the bottom. Our author, however, placed various substances above *diamond*, and *tabasheer* far below *ice*.

[2] *Phil. Trans.* 1815, p. 27.

[3] These discoveries were communicated to the Royal Society of Edinburgh, and owing to the state of communication between France and England, neither the author nor any of the members of the Society were acquainted with the previous discovery of M. Arago of the colours of crystalline plates, or with those of Malus on depolarisation and metallic polarisation.

[4] *Phil. Trans.* 1814, p. 1. [5] *Id. Id* [6] *Id.* 1815, p. 60.

[7] *Phil. Trans.* 1816, p. 46, and *Edinburgh Transactions*, vol. viii. p. 383, where the phenomena are represented by formulæ.

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volume of the *Transactions*,[1] *on the communication of the structure of doubly refracting crystals, to glass, muriate of soda, fluor spar, and other substances, by mechanical compression and dilatation;* and on the 17th November 1816, our author communicated to the Royal Society of Edinburgh another paper, *on the effects of compression and dilatation in altering the polarising structure of doubly refracting crystals.*[2]

In 1816 he communicated to the Royal Society his experiments on mother-of-pearl, explaining the origin of its fine superficial colours, and shewing that they could be communicated to wax, isinglass, the fusible metals, and even to lead, by hard pressure. In 1815 he published a paper *on the multiplication of images, and the colours which accompany them, in some specimens of calcareous spar*,[3] a subject which had exercised the sagacity of Huygens, Benjamin Martin, Brougham, Robison, and Malus. The last of these philosophers ascribed the multiplication of the images to the interception of the pencils by fissures within the crystal, and the colours to the thin plate of air which it enclosed; but Sir David Brewster discovered the true cause of the phenomena, and proved that there were no fissures nor plates of air; that the multiplication of the images arise from one or more veins of calcareous spar, which divided the rhomb into prisms, so as to form composite crystals, having the axes of crystallization and of double refraction of the two contiguous crystals turned round 180°, so that each of the two pencils formed by double refraction are subdivided in passing from the one crystal to the other. He has shewn also that the colours are the polarised tints produced by thin plates crystallized, these plates giving the regular system of coloured rings seen along the axis of calcareous spar, the light being polarised by the first prism of spar, and analysed by the last. Hence it follows that the polarised tints of crystals were seen and studied by Huygens and his successors, without having any idea of what they were.

The crystalline lenses of animals had hitherto been supposed to increase regularly in density, from the circumference to the centre, for the purpose of correcting the spherical aberration. Sir David Brewster, however, shewed, in 1816,[4] that there were often *three* structures in such lenses, a structure increasing in density from the centre, being accompanied with another diminishing in density, and that these structures displayed themselves in circular rings of polarised tints, traversed by a rectangular black cross, the tints themselves sometimes rising to a bright yellow of the first order. About the same time he discovered the remarkable property of the *diamond*, of exhibiting irregular patches of doubly refracting structures, as if it had been in the state of gum, subject to irregular pressure, or induration;[5] and having afterwards discovered gaseous cavities in the same gum, in which the expansive pressure of the included gas had communicated to the surrounding parts a regular doubly refracting structure, he corroborated his supposition that it had a vegetable origin,[6] which he has more recently confirmed by discovering that many diamonds consist of strata of different refractive powers, a property not possessed by any mineral body.[7]

In the beginning of February 1815, when examining the action of metals upon polarised light, our author discovered that complementary colours were produced by one or more reflexions from plates of gold, silver, and other metals; that analogous colours were produced by total reflexion; that common light was wholly polarised in the plane of incidence by a number of metallic reflexions, this number being greater in silver and gold than in the other metals. Though examined with much care both by our author and M. Biot,[8] the nature and law of these phenomena were still veiled in obscurity.

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Hitherto all crystals were believed to have one axis of double refraction, like Iceland spar or quartz; but in the year 1817,[9] Sir David Brewster discovered that the greater number of crystals, and among these arragonite, sulphate of iron, sulphate of barytes, sulphate of strontian, topaz, felspar, and nitre, had *two axes* of double refraction, which he called resultant axes, and which were more or less inclined to each other, as the intensity of the real axes more or less approached to equality. By measuring the deviation of the two pencils in different planes, he found that the double refraction was the same in every part of the same ring, disappearing along the resultant axis, and increasing with the value of the tints; and by projecting the coloured rings, and measuring the angular distances from the axis at which the same tints were produced, he was led to the true physical law of the tints, and of the deviation of the extraordinary ray. This general law, when applied to the polarised tints, is thus expressed: *The tint produced at any point of the sphere, by the joint action of two axes, is equal to the diagonal of a parallelogram whose sides represent the tints produced by each axis separately, and whose angle is double of the angle formed by two planes passing through that point of the sphere and the respective axis.* When the law is applied to the phenomena of double refraction, it may be thus expressed: *The increment of the square of the velocity of the extraordinary ray produced by the action of two axes of double refraction, is equal to the diagonal of a parallelogram whose sides are the increments of the square of the velocity produced by each axis separately, and calculated by the law of Huygens, and whose angle is double of the angle formed by two planes passing through the ray and the respective axis.* When the two rectangular axes are of equal intensity and of the same character, the preceding law gives the very same results as the law of Huygens does for one axis placed at right angles with the other two. When the crystal has three equal rectangular axes, their forces are in equilibrio in every part of the sphere, and there is neither double refraction nor polarisation. When the first of these laws is applied to the mysterious actions of sulphate of lime, with the origin and classification of which M. Biot had been so much perplexed, and which he has represented by complicated and empirical formulæ, the whole mystery disappears, and *all* the diversified and capricious variations of tint which he had ascribed to secondary forces, become the legitimate and calculable results of two axes of double refraction.

During these laborious researches, our author was led to the law by which the primitive forms of minerals are connected with the number of their axes of double refraction, and to point out the connexion between the optical structure and chemical composition of crystals.

The absorption of common light, in virtue of which crystals exhibit different colours, or shades of colour, in different directions, had been long observed by Wollaston, Cordier, Bournon, De Drée, and others; but Sir David Brewster discovered that in a great number of coloured crystals, both with one and two axes of double refraction, polarised light was absorbed, according to regular laws depending on the inclination of the ray to the axis or axes of the crystal, and that in such crystals the two pencils are always differently coloured, the difference of colour disappearing in the direction of the axis, and rising to a maximum at right angles to it. These phenomena are finely seen in super-acetate of

1 *Edinburgh Transactions*, vol. viii. p. 156.

2 *Id.* vol viii. p. 281.

3 *Phil. Trans.* 1815, p. 270, and *Edinburgh Transactions*, vol. viii. p. 165.

4 *Phil. Trans.* 1816, p. 311.

5 *Edin. Trans.* 1816, vol. viii. p. 167.

6 *Geological Trans* 1816.

7 See our art. MICROSCOPE, vol. xv. p. 30.

8 *Traité de Physique*, tom. iv. p. 579.

9 *Phil. Trans.* 1818, p. 199.

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copper, dichroite, Brazilian topaz, and augite. These properties are shewn by our author to be singularly modified by heat, and even communicated to crystals which do not naturally possess it. Absorbing crystals have been called *dichroitic*, and the property itself *dichroism*.

The subject of circular polarisation was likewise examined by our author in quartz and amethyst.[1] He found that heat entirely removed from quartz the power of producing circular polarisation, when the substance was reduced to fusion; he discovered it near the resultant axis of chrysoberyl, and in certain specimens of unannealed glass.[2] In examining the proportions of the amethyst, he found that this interesting mineral combines the opposite structures of the two kinds of quartz, being composed of alternate strata of right and left-handed quartz, these two opposite actions destroying each other at their junction, where the colouring matter of the amethyst is principally apparent.

In all the experiments on the polarisation of light by reflexion from crystallised surfaces, their action was supposed to be the same as that of common solids and fluids, and Malus had distinctly stated it as the result of experiment, that Iceland spar had the same polarising angle on all its surfaces and in every azimuth, its action being "independent of the position of the principal sections," "that its reflecting power extends beyond the limit of the polarising forces of the crystal, and that as light is only polarised by penetrating the surface, the force which produces extraordinary refraction begins to act only at this limit."[3] Doubting the accuracy of these results, Sir David Brewster instituted a series of experiments *on the action of crystallised surfaces upon light*, by which he has established the remarkable fact that the angle of complete polarisation varies from 57° 14′ to 59° 32′, on the surface of the rhomb of calcareous spar, being a minimum in the plane of the principal section, and a maximum in a plane perpendicular to it. But it is not merely the polarising angle that is changed. When the ordinary reflecting force is weakened by causing the reflexion to be made from the refracting surface of oil of cassia and Iceland spar, he found that the light was no longer polarised in the plane of reflexion, and that the deviation from this plane depended on the inclination of the ray to the axis of the crystal, the deviation becoming less and less as the refractive power of the fluid was diminished. In the same paper he has shewn that by altering the mechanical condition of the surfaces of crystals, and making the ray enter this surface from fluids of different refractive powers, the ordinary or the extraordinary image may be weakened or extinguished at pleasure.[4]

In the year 1816, Sir David Brewster discovered a remarkable system of coloured rings in apophyllite, a singularly constituted crystal, one part of which has one axis, whilst another part has two axes of double refraction. Different parts of this crystal possess different degrees of double refraction, with the same thickness, and at the same inclination to the axis; and the beautiful and symmetrical figure which a perfect crystal exhibits by polarised light, delineated in the most splendid colours, is perhaps the finest sight which the mineral kingdom can present to us.[5] By the aid of polarised light, our author discovered also a singular structure in certain crystals of chabasie, in which the double refraction gradually diminishes in successive strata, then vanishes, and reappears with an opposite sign, the one double refraction being positive and the other negative; but the most remarkable of all these structures was that of *analcime*, in which he discovered a new species of double refraction, in which the phenomena are related to planes in place of axes, in which the double refraction disappears.[6]

In the year 1829, our author communicated to the Royal Society of London six papers. The first of these was *on the reflection and decomposition of light at the separating surfaces of media of the same and of different refractive powers*.[7] The second, entitled, *on periodical colours produced by the grooved surfaces of metallic and transparent bodies*,[8] contains an account of a new series of periodical colours exhibited by grooved surfaces, which succeed each other in a plane at right angles to that in which the usual spectra are seen, and producing a singular modification of these spectra; phenomena not yet brought within the pale of the undulatory theory. In the third paper, *on the double refraction produced by pressure in the molecules of bodies*,[9] he has shewn that the axis of pressure is a regular axis of double refraction, and that the doubly refracting properties, which are not inherent in the molecules themselves, are produced by the pressure caused by the forces of aggregation, which generally differ in intensity in the direction of the three rectangular axes. The same author has more recently succeeded in producing regular double refraction by the expansive presence of heat. The other three papers treat of the laws of the polarisation of light by reflexion[10] and refraction,[11] and on the action of the second surfaces of transparent plates[12] upon light. In these papers he has given formulæ for computing the quantities of light polarised at all incidences, both by reflexion and transmission; and has explained all the phenomena of partial polarisation, and those produced by any number of successive reflexions and transmissions. In the last of these three papers our author shews that the quantity of polarised light in the light reflected and transmitted by a transparent plate is not equal at all angles of incidence, and that the proposition is true when applied to surfaces alone, the apparent equality in the first case being produced by unexcluded light polarised perpendicular to the plane of reflexion.

We have already seen that Malus, Biot, and Sir David Brewster had been baffled in their attempts to unravel the complex phenomena of metallic polarisation. The last of these authors had at various times resumed the investigation; but it was not till February 1830, that he communicated the result to the Royal Society, in a paper entitled, *on the phenomena and laws of elliptic polarisation, as exhibited in the action of metals upon light*.[13] All the phenomena of metallic polarisation are shewn to be those of elliptical polarisation, connecting the phenomena of circularly polarised light with those of plane polarised light, the action of *silver* approaching nearest to that of totally reflecting surfaces by which circular polarisation is produced, and that of *galæna* to transparent bodies or those not metallic, by which plane polarisation is produced. The colours accompanying these phenomena have no relation to those of crystallised plates, and in the case of silver and gold are extremely beautiful and splendid.

Hitherto the analysis of solar light by Sir Isaac Newton had been regarded as complete, and incapable of any farther development. From this analysis he himself deduced the conclusion, *that to the same degree of refrangibility ever belonged the same colour*, and to the same colour ever belonged the *same degree of refrangibility*. So early as 1822, in a paper, on the *monochromatic lamp*, &c.,[14] Sir David Brewster shewed that some of the colours of the spectrum

[1] *Edin. Trans.* vol. ix. p. 139.
[2] *Treatise on Optics*, Lardner's Cabinet Cyclopædia, p. 128.
[3] *Théorie de la Double Refraction*, p. 240.
[4] *Phil. Trans.* 1819, p. 145.
[5] *Edin. Phil. Journal*, vol. i. p. 1, and *Edin. Trans.* vol. ix. p. 317.
[6] *Id.* vol. x. p. 187.
[7] *Phil. Trans.* 1829, p. 187, or *Edin. Jour. of Science*, N.S., vol. i. p. 204.
[8] *Id.* p. 301, or *Edin. Jour. of Science*, vol. ii. p. 46.
[9] *Id.* 1830, p. 87, or *Edin. Jour. of Science*, vol. iii. p. 28.
[10] *Id.* 1830, p. 69, or *Edin. Jour. of Science*, N.S., vol. iii. p. 160.
[11] *Id. Id.* p. 135, or *Id. Id* p. 218.
[12] *Id. Id.* p. 145, or *Id. Id.* p. 230.
[13] *Id. Id.* p. 287, or *Id. Id.* No. 5, vol. iv. p. 136, 247.
[14] *Edin. Trans.* vol. ix. p. 433.

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were *compound*, capable of being analysed by absorbing media, and that *different colours had the same refrangibility*. This result stood in direct opposition to the Newtonian doctrine, and our author, in order to support it, undertook an elaborate series of experiments the results of which were communicated to the Royal Society of Edinburgh in 1831, in a paper entitled, *on a new analysis of solar light*, indicating *three primary colours forming coincident spectra of equal lengths*.[1] In these three overlapping spectra the intensity of each colour is a maximum at that point where the same colour is most intense in the compound spectrum. Hence it follows that all the colours in the solar spectrum are compound, consisting of red, yellow, and blue light in different proportions, so that if at any point we separate as many rays of each colour as is necessary to produce *white* light, by absorbing the excess at that point, we should exhibit the strange phenomenon of *white light incapable of being decomposed by the prism*. This has actually been done by Sir David Brewster, by means of absorbing media. But in a very recent communication made to the Royal Society, (in June 1837), he has explained a new method of effecting this by perfectly transparent media, which he calls *analysis by dissection*, and of which we shall give some account in another part of this article. This paper was followed, in 1833, by another, *on the colours of natural bodies*,[2] in which our author shews that they have not the same composition as those of thin plates, and demonstrates the truth of this opinion by a special analysis of the green colour of plants, the most prevalent tint in nature, and the one which Newton had pronounced to be of the third order. In the same year our author published his *Observations on the Lines of the Solar Spectrum, and on those produced by the earth's atmosphere, and by the action of nitrous acid gas*,[3] but we must reserve our notice of this paper till we come to describe the discoveries of Fraunhofer.

Dr. Seebeck. Born 1770. Died 1831.

The late Dr. Thomas John Seebeck of Nuremberg, was an active and successful cultivator of the science of Optics. His first experiments on this subject were published in Schweigger's Journal for April 1813 and December 1814. In 1811 M. Arago observed the polarising structure in thick pieces of flint, and in 1812 Sir David Brewster had noticed the same property in some pieces of plate glass.[4] In Dr. Seebeck's paper of 1813, he observed the regular figure produced by polarised light, when the glass had the regular form of cubes and cylinders. In cubes of an inch in diameter, he found them to be indistinct, and not produced by fluor spar or rock salt. In his second paper of December 1814, he shews that a plate of glass made red hot, and set upon its edges to cool, exhibits at the part which cools first a series of coloured fringes, which spread over the whole plate, the structure which produces them remaining permanently fixed in the glass. These experiments are posterior to those made in Scotland on the effects of heat upon glass, and on the polarising structure of glass cooled in water.

Early in 1816, Dr. Seebeck discovered the property of certain essential oils in producing the polarised tints, the property of single refraction possessed by tourmaline, and the system of coloured rings produced by Iceland spar; but in these discoveries he was anticipated, as we have seen, by others, though he is entitled to all the merit of a second discoverer.

In 1809 Dr. Seebeck communicated to the Academy of Sciences at Berlin, an interesting memoir *on the unequal production of heat in the prismatic spectrum*,[5] in which he shewed that the place of maximum heat varied with the substance of which the prism was made, being in the *yellow rays* in the spectra formed by water, (and according to Wunsch, in alcohol and oil of turpentine); in the *orange* in concentrated sulphuric acid, and solution of sal ammoniac and corrosive sublimate; in the *middle of the red* in crown and plate glass, and *beyond* the red in flint glass. Dr. Turner[6] ascribed these results to the different powers of these media to refract the rays of solar heat; but Sir David Brewster explained them by supposing that colourless transparent bodies exercise the same variety of absorptive action upon heat that coloured bodies do upon light, the body in the last case becoming coloured in consequence of that action. Hence the maximum ordinate of heat will shift its position with the nature of the body, and we shall no doubt find media, several maxima and minima, and points of no heat at all, according as we increase the size of the prism or the thickness which the heat traverses.[7] The best way to carry such researches is to use a prism of glass whose curve of heat is well ascertained, and then to determine the changes which take place in the curve by interposing thick plates of transparent solids and fluids.

This eminent philosopher would have done still more for the science of optics, had he not been attracted to the study of thermo-electricity, in the creation and extension of which he has immortalised his name.

Dr. Seebeck.

We are indebted to Dr. A. Seebeck for a series of instructive and accurate experiments on the polarising angle of different substances, which confirm the accuracy of the law of the tangents,[8] and another on the polarising angle of calcareous spar in different azimuths.

Fresnel. Born 1788. Died 1827.

We come now to that auspicious period in the history of optics, when this science was destined to receive the grandest accessions from the genius of M. A. Fresnel, engineer of roads and bridges. What Newton did for astronomy, Fresnel did for physical optics; and all Europe will, we are persuaded, confirm the decision which places him pre-eminently above all the other cultivators of this branch of science. The discoveries of Fresnel, however, are so connected with theoretical considerations, that it is impossible, in a historical sketch, to give any thing like an idea of their magnitude and importance. The phenomena of rotatory polarisation in quartz, which had so much perplexed philosophers, have been completely explained by Fresnel. He found that they arise from the interference of two circularly polarised pencils, propagated with different velocities along the axis of quartz, the one revolving from right to left, and the other from left to right, and that a plane polarised ray is equivalent to two circularly polarised rays of half the intensity. These facts he verified experimentally, by an achromatic combination of right and left-handed prisms of quartz, so disposed as to double the refraction of the images.

M. Fresnel had also found that light was circularly polarised by two total reflexions from glass at an angle of about 54° 37′, and by placing between two rhombs of glass, each of which polarised the light circularly and had their planes of reflexion at right angles to each other, a crystallised plate, he observed the light transmitted through this system exhibited phenomena analogous to those seen along the axis of rock crystal. The rhomb of glass so cut, that when the incident rays enter and leave it perpendicularly, they have suffered two reflexions at an angle of 54° 37′, is well known by the name of Fresnel's rhomb.

Fresnel's theory of double refraction and polarisation, one of the finest efforts of genius, conducted its author to many important results which had escaped the notice of the most diligent observers. Hitherto it had been taken for granted by all, and appeared to be proved by Biot's experiments on topaz, that in biaxal crystals one of the rays

[1] *Edin. Trans.* vol. xii. p. 123, or *Edin. Journal of Science*, new series, vol. v. p. 197.
[2] *Id. Id.*
[3] *Id. Id.*
[4] *Treatise on New Phil. Inst.* p. 335.
[5] *Berlin Memoirs*, 1818–1819, p. 305, or *Edin. Jour. of Science*, vol. i. p. 358, No. 2, Oct. 1824.
[6] *Chemistry*, 3d edit. p. 84.
[7] *Second Report of the British Association*, 1832, p. 294.
[8] *Edin. Jour. of Science*, N. S. vol. v. p. 99.

followed the ordinary law of the sines; but it followed from Fresnel's theory that it did not, and by a series of the nicest and most difficult experiments he determined, that neither of the two rays have a constant velocity, both being performed according to a new law. What had been called the extraordinary ray, he found by his theory to be regulated by the law discovered by Sir David Brewster, and simplified in its mathematical expression by M. Biot, and he shewed that all the phenomena of double refraction could be accurately calculated. The axes of elasticity in Fresnel's theory are the same as the axes of double refraction in Sir David Brewster's, and the laws of the composition and resolution of such axes in uniaxal, biaxal, and tessular crystals, which have no double refraction previously given by the latter, are all necessary results of the same theory.

But the most remarkable part of Fresnel's theory is his explanation of the polarisation of light. The hypothesis of *transversal vibrations* first presented itself to Dr. Young while considering the law of extraordinary refraction in biaxal crystals, as communicated to him by Sir David Brewster. M. Fresnel, however, shewed that it was a necessary consequence of the laws of interference, and that the vibrations of a polarised ray are on the surface of the wave, and perpendicular to the plane of polarisation. In unpolarised light they are also only on the surface of the wave, and this species of light is conceived to "consist of a rapid succession of systems of waves polarised in every possible plane, passing through the normal to the front of the wave." Hence light is polarised by resolving the vibrations into two sets in two rectangular directions.[1]

We have already slightly noticed the fine discoveries of MM. Arago and Fresnel on the interference of polarised light, and we can now only refer with admiration to the beautiful series of experiments by which the phenomena of moveable polarisation were properly explained, and brought under the dominion of the undulatory theory. When a polarised ray proceeding from a luminous point was transmitted through two rhomboids of Iceland spar of equal thickness, whose principal sections were inclined 45° to the plane of primitive polarisation, the emergent light will diverge as if from two near points, and the two portions will be oppositely polarised. MM. Arago and Fresnel found that the light formed by the union of these pencils was *plane*, *circularly*, or *elliptically* polarised, according to the difference of the paths traversed when they met. Following out this principle, MM. Arago and Fresnel were led to an *experimentum crucis*, to determine the accuracy of the theory of moveable polarisation. A homogeneous ray of polarised light was transmitted through a plate of sulphate of lime, having its principal section inclined 45° to the plane of primitive polarisation, and of such a thickness that it should be circularly polarised according to the undulatory theory, and plane polarised according to the other; and the result was decisive against the theory of moveable polarisation.

We owe also to M. Fresnel the true theory of the inflexion or diffraction of light. The Institute of France made this the subject of their physical prize for 1818, and the memoir of our author was the successful one. He had at first adopted and extended the theory of Dr. Young, that the fringes arise from the interference of the direct and inflected light; but he was afterwards obliged to admit, that rays passing at a sensible distance from the reflecting body, deviate from their primitive direction, and interfere with the direct light. This interesting effect he ascribes to a number of elementary waves sent from each portion of the surface of the principal wave when it reaches the reflecting body, and he determines the resultant of all the elementary waves sent by these portions to a given point. Upon applying this theory to various cases of inflexion, he found it to agree so well with observation, that, with the exception of the case of diffraction by narrow apertures, the theory did not err more than the 2500th part of an inch.

Among the many important discoveries of Fresnel we must enumerate the theory of the reflexion of light. Dr. Young had shewn on the undulatory theory, that at a perpendicular incidence the intensity of the reflected light was a very simple function of the index of refraction.[2] M. Poisson had arrived by another process at the same result, without knowing, we believe, what had been done by Dr. Young;[3] and he afterwards extended his inquiries to different incidences.[4] The conclusions, however, at which this distinguished mathematician arrived, were inconsistent with observation; and Fresnel had the good fortune to give a complete solution of the problem, by combining the doctrine of transversal vibrations with the theory of waves. He assumes, that the elasticity of the ether in the two media are equal, but their density different, though he also solved the problem on the more general assumption, that the elasticity was different in the two media. He thus obtained formulæ for all incidences and all refractive powers, and the law of the tangents, as well as that of the equality of pencils, polarised by reflexion and transmission, became the consequences of these formulæ. At a perpendicular incidence the formula coincides with that of Young and Poisson, and at 90° the whole light is reflected, a result which has been verified by observation.[5]

Fraunhofer Born 1787. Died 1826.

Contemporary with the discoveries of Fresnel were those of the late M. Fraunhofer of Munich, who made several important observations on the solar spectrum, on the diffraction of light, on refractive and dispersive powers, and on the refrangibility of the light of the fixed stars. By using fine prisms entirely free of veins, he discovered that the solar spectrum was crossed by about 590 black lines, and he executed a beautiful drawing of the spectrum, in which the most important of these are projected. Fraunhofer was not aware that Dr. Wollaston had previously discovered *seven* of these lines; but this slight anticipation does not in the least degree diminish the singularity of this splendid discovery. He discovered similar lines in electric light, and in the spectra of the Moon, Venus, Mars, Castor, Pollux, Sirius, Capella, Betalgeus, and Procyon;[6] but none whatever in artificial white flames. These lines he found to have a fixed position in relation to the coloured spaces, and, by measuring accurately the distance of prominent lines in the different coloured spaces, he obtained measures of the refractive and dispersive powers of bodies with a degree of accuracy hitherto unknown. Fraunhofer considered these lines as having their origin in the nature of the sun's light; but Sir David Brewster, who by particular methods has discovered more than twice the number of lines reckoned by Fraunhofer, has established the curious fact, that many of them are produced also by the action of the earth's atmosphere. In his researches on this subject Sir David Brewster discovered the remarkable property possessed by nitrous gas of producing analogous lines in great numbers, increasing in width with the thickness of the gas, or with an augmentation of its temperature. "The power of heat alone," says this author, "to render a gas, which is almost colourless, as red as blood, without decomposing it, is in itself a most singular result; and my surprise was greatly

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[1] See *Bulletin de la Soc. Philomathique*, 1824, and *Mém. de l'Institute*, tom. xvii.
[2] See the article CHROMATICS, written by Dr. Young, vol. vi. p. 650.
[3] *Mém. de l'Inst.* tom. ii.
[4] *Id* tom. x.
[5] See *Ann. de Chim.*, 1821.
[6] *Edin. Journal of Science*, No. xv. p. 7. Sir David Brewster asserts, that all the coloured stars derive their colours from defective lines in their spectra, having found these lines in those most strongly coloured.

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increased, when I afterwards succeeded in rendering the same pale nitrous acid gas so absolutely black by heat, that not a ray of the brightest summer sun was capable of penetrating it."[1] Professors Miller and Daniel afterwards discovered numerous fixed lines disposed at equal distances, in the vapour of bromine and iodine, and Sir David Brewster has very recently discovered hundreds of lines under very singular circumstances, in the spectrum of an artificial substance, resembling mother-of-pearl;[2] but what is most interesting, these lines are *moveable*, *shifting their place in the spectrum by varying the incidence*, and are produced by the periodical action of *thin plates* enclosed in the substance. He has also discovered, that broad dark bands like those produced by absorbing media, but entirely different from the nearly equidistant bands formed by single thin plates, are produced by a number of thin plates in a state of combination.[3]

Considering the lines of the spectrum as produced by interference, Fraunhofer was induced to make a complete series of experiments on the *inflexion of light*, particularly on the splendid colours produced by gratings of wires, and grooved surfaces, which were published in the year 1822, in the *Memoirs of the Royal Bavarian Academy of Sciences*.[4] He afterwards repeated these experiments with a finer apparatus, and communicated an account of them to the Academy of Sciences at Munich, on the 14th June 1823.[5] The science of optics owes also to Fraunhofer the art of making the finest glass for achromatic telescopes and prisms, and such was the perfection at which he arrived, that, in a letter to the author of this article, he expresses his willingness to undertake an achromatic object glass *eighteen inches in diameter*. Our author wrote also a treatise on halos, parhelia, &c., in which he ascribes the small solar and lunar halos to the inflexion of light, by particles of vapour in the atmosphere, and the great halos of 45° to the refraction of hexagonal prisms of ice.[6]

Sir John Herschel.

Among the most distinguished contributors to optical discovery, Sir John Herschel occupies a high place. The deviations of the polarised tints from the colours of thin plates, or those of Newton's scale, had been discovered by Sir David Brewster in acetate of lead, tartrate of potash and soda, apophyllite, topaz, and various other minerals. He had divided these crystals into two classes, viz. those that had the *red* ends of the rings *inwards*, and the *blue* ends *outwards;* and those that had the *blue* ends of the rings *inwards*, and the *red* ends *outwards*.[7] In his paper of 1818, he states, that "in almost all crystals with two axes, the tints in the neighbourhood of the resultant axes, when the plate has a considerable thickness, lose their resemblance to those of Newton's scale, as will be more minutely described in another paper." Conceiving that these deviated tints arose from the superposition of systems of rings of different colours, Sir John Herschel examined the coloured rings by homogeneous light, and established the important fact that the inclination of the resultant axes varied in the different colours of the spectrum, the poles or centres of the rings approaching to each other in red, and receding in violet light, in some crystals; while in others they receded from each other in red, and approached in violet light. In tartrate of potash and soda, for example, the inclination of the axes was 75° 42′ in *red*, and only 55° 14′ in *violet* light.[8] These various axes all lie in the same plane, excepting in borax. In the paper containing this discovery, and in other two,[9] communicated to the Cambridge Philosophical Society, he has described various interesting phenomena which he discovered in different specimens of apophyllite and in hyposulphate of lime,[10] and which led him to some interesting conclusions respecting the law of proportional action of these crystals on the different colours of the spectrum.

We have already seen that the force which produces circular polarisation had been deemed a property of the ultimate particles of bodies, and totally unconnected with their mode of aggregation. In 1820 Sir John Herschel made the beautiful discovery, that the direction of the circular polarisation in quartz was invariably the same with that of the plagiedral planes round the summit, the direction of the polarisation being retrograde or direct, according as these planes leant forward or backward round this summit.

We owe also to Sir John Herschel an interesting inquiry into the *aberrations of compound lenses and object-glasses*,[11] a series of curious experiments on the phenomena produced by diaphragens or apertures of various shapes, variously applied to mirrors and object-glasses,[12] and a great number of original views and valuable experiments, which are contained in his *Treatise on Light*, one of the most valuable and original works on science which has appeared during the last century.

M. Mitscherlich.

M. Fresnel was, we believe, the first person who observed the change produced by heat on the tints of sulphate of lime. It is to M. Mitscherlich, however, that we owe the most complete investigation of this subject. He found that heat expands crystals differently in different directions. Iceland spar is expanded by it in the direction of its axis, while it is in a slight degree contracted in directions perpendicular to the axis. The rhomb thus approaches to the cube, and the double refraction is diminished. M. Mitscherlich also found that the inclination of the optical or resultant axes, which is about 60°, diminishes with heat till they actually form one axis, when by a farther increase of heat they again separate, and open out, as it were, in a plane at right angles to that of the laminæ. We have repeated this experiment, and enjoyed the remarkable sight of observing the one system of rings marching towards the other in the plane of the laminæ, and changing their form and size as they advanced.[13] An analogous, and even a more remarkable property, was discovered by Sir David Brewster in glauberite. At the freezing point glauberite has two optical axes for all the colours of the spectrum, the inclination of the axes being *greatest* in *red*, and *least* in *violet* light. When heat is applied, the two axes approach, and those of different colours unite successively, the crystal possessing the remarkable property of being a *uniaxal* one for *red*, and a *biaxal* one for *violet* light. By increasing the temperature, the optical axes open out in the same order, but in a plane at right angles to that in which they formerly lay, and long before the temperature has reached that of boiling water the planes of the axes in all the prismatic colours are perpendicular to their first position.[14] Such a crystal would form a delicate chromatic thermometer.[15] M. Marx has discovered an analogous property in topaz, in which the two axes separate with heat, the variation being greater in the coloured than in the colourless varieties.[16] Sir David Brewster has discovered that regular double refraction is produced in some soft substances by the application of heat.

M. Rudberg.

Some very excellent and interesting results have been obtained by M. Rudberg, on the effect of heat upon doubly

1 *Edin. Trans.* vol. xii.
2 *Phil. Trans.* 1837.
3 *Id. Id.*
4 Vol. viii. 1822.
5 *Edin. Journal of Science*, No. xiii. p. 101, 251.
6 See *Phil. Trans.* 1814, p. 204, 205, and 1820, p. 95.
7 *Edin Jour. of Science*, No. xii. p. 348.
8 *Phil. Trans.* 1820, p. 45.
9 *Cambridge Trans.* vols. i. and ii.
10 Sir John discovered similar deviations in vesuvian or idocrase. —*Treatise on Light*, art. 1125.
11 *Phil. Trans.* 1821, p. 222.
12 *Treatise on Light*, § 767, 768, &c.
13 *Lond. and Edin. Phil. Mag.* 3d series, vol. i. p. 417.
14 *Edin. Trans.* vol. xi. p. 273, and *Lond. and Edin. Phil. Mag.* 3d series, vol. i. p. 417.
15 *Phil. Trans.* 1818, p. 108.
16 *Jahrbuch der Chimie*, vol. ix.

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refracting crystals. He found that the extraordinary ray in calcareous spar (the line F was used) had its deviation increased 2′ 34″, as the refractive index increased 0·00043, by a rise of temperature equal to 64°, the refracting angle of the prism being 59° 55′ 9″, whereas the refractive power for the ordinary ray either does not change at all, or decreases with the temperature by a quantity extremely small. In rock crystal he found the deviation to be 42″, or 0·00027, both on the ordinary and extraordinary ray, the angle of the prism being 45° 20′ 5″. In arragonite he found that the double refraction decreased a little with the temperature.[1]

We owe also to M. Rudberg a series of valuable experiments on the refractive actions of the differently coloured rays in crystals with one and two axes of double refraction. His measures were taken in reference to the fixed lines in the spectrum, and the minerals he employed were rock crystal, calcareous spar, arragonite, and colourless topaz. He confirmed the existence of two dispersive powers in doubly refracting crystals, announced long before by Sir David Brewster; and the variation of the inclination of the optic axes with the different colours of the spectrum, which had also been previously discovered by Sir John Herschel.[2] M. Rudberg was no doubt unacquainted with the previous labours of these authors, otherwise he would not have passed them over without notice.

M. P- son. Born .81.

Like every other branch of physical science, optics owes much to the profound researches of M. Poisson, which are in general of too recondite a nature to find a place in a popular treatise. The theory of the colours of thin plates was left incomplete by Dr. Young. The two interfering portions from the upper and under surface of the plate were obviously unequal, and therefore could not destroy one another wholly by interference, as they are found to do. M. Poisson remedied this defect by shewing that there must be an infinite number of partial reflexions within the plate, at each of which a very small portion of light was reflected, so that the sum of all these portions of light makes up for the defect of one of the pencils, and makes the interfering pencils equal. Hence M. Poisson has shewn that at a perpendicular incidence, and at points where the effective thickness of the plate is an exact multiple of the length of half an undulation, the intensity of the reflected and transmitted light will be the same as if the plate were suppressed altogether, and the bounding media in absolute contact, so that when these media have the same refractive power, no light will be reflected and the whole transmitted. By the aid of the property discovered by M. Arago, that the light is reflected in the same proportion at the first and second surfaces of a plate, M. Fresnel extended M. Poisson's conclusions to all incidences.

In treating of the subject of diffraction, M. Poisson was led to the curious result that the centre of the shadow of a small opaque circular disc, exposed to light diverging from a single point, is as much illuminated by the diffracted light as it would be by the direct light, if the opaque disc were removed. By cementing a small metallic disc upon a plate of pure and homogeneous glass, M. Arago verified this remarkable deduction of theory.

M. Poisson's researches on the propagation of motion in elastic fluids, and their application to light, are too profound to admit of a brief and intelligible analysis.

Ampèr Born 1 5.

In two memoirs read to the Academy of Sciences in 1828,[3] M. Ampère has made a valuable addition to the theory of Fresnel. By an indirect and not very rigorous process, M. Fresnel had been led to the equation of the wave surface;[4] but M. Ampere obtained a direct demonstration of it, deducing the equation in the manner which Fresnel had merely indicated, and he derived from this equation the elegant geometrical construction obtained indirectly by Fresnel.

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M. Cauchy.

The undulatory theory of light has been greatly advanced by the researches of M. Cauchy, a French mathematician of distinguished eminence. In determining the law of propagation of a plane wave, he shews that a disturbance originally limited to a given plane will give rise to three pairs of plane waves with uniform velocities, and parallel to the original plane, the two waves of each pair moving in opposite directions, but with equal velocities. He shews that the separate pairs will move with velocities represented by the reciprocals of the axes of an ellipsoid, the form of which is regulated by the position of the plane wave, and the nature of the system, the absolute displacement of the molecules being parallel to the direction of these axes. Hence a system of plane waves superposed at the point of original disturbance, will be divided into three corresponding systems, and these will generate by their superposition a curved surface of three sheets, each sheet being touched by all the plane waves of the system. If these principles are established, it will follow as a necessary consequence *that a single ray of light will be divided into three polarised rays*, one of which will in all cases have little intensity. M. Cauchy, as Professor Lloyd[5] remarks, has not pointed out the method of discovering this ray, or stated the precise physical condition on which its existence depends; but it "would seem to arise from the circumstance that the vibration normal to the wave is not absolutely insensible, so that the actual vibrations are not accurately in the plane of the wave."[6] "The results of M. Cauchy's general theory," continues Professor Lloyd, "embrace and confirm those of Fresnel; and the mathematical laws of the propagation of light are shewn to be particular cases of the more general laws of the propagation of vibratory motion in any elastic medium composed of attracting and repelling molecules. Considered, however, simply with reference to the theory of light, the solution given by M. Cauchy cannot, I conceive, be considered as a complete *physical* solution. In other words, the phenomena of light are not connected *directly* with any given physical hypothesis; but are shewn to be comprehended in the results of the general theory, in virtue of *certain assumed relations* among the constants which that theory involves. If, indeed, we were able to assign the precise physical meaning of these equations of condition, we should have nothing more to desire in the general theory of light; for these equations must necessarily express the characteristic properties of the vibrating medium. In this point of view, their discussion becomes a subject of the highest interest; and it is probable that the important conclusions of which we have yet to speak, may in this manner be confirmed and extended."

Triple refraction.

Before quitting this subject, however, we ought to mention that there is an essential difference between the theories of Fresnel and Cauchy. In the former a ray is said to be polarised in or parallel to any plane, when the vibrations of the molecules of ether are *perpendicular* to that line or plane; whereas, in Cauchy's theory, a ray is said to be polarised in or parallel to any plane, when the vibrations of the ether are performed in a parallel to that plane.

Dispersion of light.

The inability of the undulatory theory to explain the dispersion of light, was long one of the few exceptions to its universal application. Dr. Young supposed that the material particles of bodies are incapable of permanent vibrations; that these vibrations will retard those of the ether; and that this retardation will be proportional to their frequency. The Rev. Mr. Challis, adopting Dr. Young's idea, has endeavoured to explain the manner in which the undulations of

[1] *Lond. and Edin. Phil. Mag.* vol. i. p. 409.
[2] *Id. Id.* vol. i. p. 1, 89, 136, 146.
[3] *Ann. de Chémie*, tom. xxxix.
[4] *British Association*, 4th report, p. 391.
[5] *British Association*, 4th report. p. 391, 2.
[6] See p. 375, (note).

History. the ether within bodies are modified by their material atoms. He supposes that a sensible reflexion takes place at every interruption of continuity in the medium; and he infers that the mean effect produced by a retarding cause proportional to the reflective power of the atoms, will be to make the condensation corresponding to a given velocity greater in a certain proportion than in free space, and to diminish the velocity of propagation in the same proportion. Mr. Airy has more recently endeavoured to remove this difficulty, by supposing that in refracting media there may be something depending on time which alters their elasticity, in the same manner as in air the elasticity is greater with a quick than with a slow vibration of particles.

An anonymous writer in a very recent number of *The Philosophical Magazine*, has proposed another hypothesis for obtaining a difference of elasticity. He supposes that the ether accumulates itself round the particles of transparent media, and forms spheres of a density increasing towards their centres; and he infers that a succession of vibrations communicated through a medium thus constituted will give rise to new vibrations propagated with various velocities corresponding to those of the different rays in the spectrum.

The complete removal of this difficulty from the undulatory theory has been effected by the skill of M. Cauchy. Regarding the sphere of action of the ethereal molecules as indefinitely small, in comparison with the length of an undulation, it had been inferred that the velocity of the undulations must be constant in the same medium; but this restriction being removed as a groundless one, M. Cauchy has considered the problem in a more general manner, and has arrived at the result, that there exists a general relation between the length of the undulations and the velocity with which they are propagated, or the index of refraction; and consequently that rays of different colours will have different degrees of refrangibility. This relation is expressed by an equation involving two arbitrary constants, depending on the nature of the medium, and determinable by two values of the index of refraction for two waves of a known length. The refractive index for waves of other lengths may then be computed. Professor Powell has done this for several media,[1] whose refractive indices for the fixed lines in the spectrum have been determined by Fraunhofer, Rudberg, and himself; but though there is a general coincidence with the theory, the differences are in some cases rather inauspicious.

M. Cauchy has more recently deduced from his general theory the remarkable fact, that in a particular case of reflexion the reflected pencil exceeds the incident one in intensity, a result which has been confirmed by direct experiment.

Mr. Airy. In examining the two rays produced by the double refraction of quartz, Mr. Airy was led to a discovery which we consider as one of the most important in its results, and one of the most beautiful in its phenomena, that has yet been made in this branch of optics. The circular polarisation of the two rays along the axis of quartz had been studied by different philosophers, and had been explained by Fresnel with singular ingenuity, on the principles of the undulatory theory. No attempt, however, had been made to account for the existence of this property only in the rays which pass near the axis of the crystal, or to define the limit where the circular polarisation ended, and the plane polarisation commenced. Fresnel, and all who have written on the subject, seem to have shrunk from this difficulty; but Mr. Airy thought that the two kinds of polarisation must have some connecting link, and by the aid of theory and experiment he succeeded in discovering it. In place of the two rays in quartz consisting of plane polarised light, as was universally believed, Mr. Airy has shewn that they both consist of elliptically polarised light, the greater axis of the ellipse for the one ray being in the principal plane of the crystal, and the greater axis of the other perpendicular to that plane. One of the rays he found to be right-handed elliptically polarised, and the other left-handed elliptically polarised. The proportion of the axes of the ordinary ray is more nearly one of equality than the proportion of the axes of the extraordinary ray, each proportion being one of equality when the direction of the ray coincides with the axis, and becoming more unequal with the inclination, according to a law not yet discovered. The results calculated from the theory are in perfect accordance with those which Mr. Airy has obtained from very nice and difficult experiments; so that we may regard this beautiful and singular property of the two rays of quartz as perfectly established.

Without knowing of the beautiful experiments of M. Arago, already referred to, Mr. Airy was led to make the same experiment on the coloured rings formed between a lens and a metallic reflector, and to draw the same conclusion from it in favour of the undulatory theory. From a consideration of the formulæ of Fresnel, Mr. Airy was led to expect that if the rings were formed between two substances of different refractive powers, such as plate glass and diamond, the light being polarised perpendicular to the plane of incidence, they should have a black centre at incidences less than the polarising angle of the glass, and greater than the polarising angle of the diamond; while they should have a white centre at all intermediate angles. These anticipations Mr. Airy confirmed by experiment; and in the course of his observations he observed certain peculiarities in the phenomena, from which he has drawn the following conclusions, viz.

1. When the angle of incidence is less than the maximum polarising angle of the diamond, the nature of its reflexion is similar to that of metallic reflexion; the phase of vibration in the plane of reflexion being more retarded than that of vibrations perpendicular to the plane of reflexion, but perhaps by a smaller quantity than in reflexion from metals.

2. In the neighbourhood of the polarising angle, the nature of the reflexion is different from any that has hitherto been described. The vibrations in the plane of reflexion do not vanish, but on increasing the angle of incidence by three or four degrees, the phase of vibration is gradually retarded by about 180°. In the reflexion of light whose vibrations are perpendicular to the plane of reflexion, there is no striking difference between the effects of diamond and those of glass.

3. For angles of incidence greater than the polarising angle, there is no sensible difference between the effects of diamond and those of glass.[2]

It would be desirable to ascertain if the diamond used by Professor Airy consisted of strata of different reflective and refractive powers, a structure lately discovered in some specimens by Sir David Brewster;[3] or if it was a heterogeneous crystal, containing particles of different degrees of density and double refraction, a structure very common in this gem.[4]

Sir W. Hamilton. Hitherto the mathematical theory of light owed almost all its development to the distinguished members of the Institute of France—to Malus, Arago, Fresnel, Poisson, Ampere, and Cauchy; but it was now destined to receive a powerful impetus from those eminent members of Trinity College, Dublin, who have nobly sustained the honour of their country by their genius and discoveries. In his *Essay on the Theory of Systems of Rays*, Sir William Hamilton has given an elegant analytical form to that part of the theory of Fresnel which relates to the determination of the velocity and polarisation of a plane wave; and he has de-

[1] *Phil. Trans.* 1835–37.

[2] *Cambridge Trans.* 1832.

[3] *Treatise on the Microscope*, p.19.

[4] See the Art. MICROSCOPE, vol. xv. p. 30, and *Edin. Trans.* vol. viii. p. 157.

duced the velocity and direction of the ray from that of the wave, and consequently the form of the wave surface.[1] In these researches Sir W. Hamilton was conducted to the discovery of some new geometrical properties of the wave surface. He found that this surface has four conoidal cusps at the extremities of the resultant or optical axes, at each of which the wave is touched by an infinite number of tangent planes, forming a tangent cone of the second degree, while at the extremities of the lines of single wave velocity, there are four circles of plane contact, in every part of each of which the wave surface is touched by a single plane. These cusps and circles, the existence of which does not seem to have been suspected by Fresnel, have led Sir W. Hamilton to some remarkable theoretical conclusions respecting the laws of refraction in biaxal crystals. To this new property he has given the name of conical refraction, because a single ray is refracted into an infinite number, forming a kind of cone. This conical refraction is of two kinds, external and internal. In external conical refraction, one internal cusp ray corresponds to an external cone of rays; and in internal conical refraction, an external ray incident at an angle corresponding to the line of single wave velocity within, is connected with an internal cone of rays.[2]

Professor Lloyd.

Sir W. Hamilton requested Professor Lloyd, of Trinity College, Dublin, to inquire experimentally into the existence of these two kinds of conical refraction. For this purpose he selected arragonite, a crystal of great biaxal energy, and having its optic axes inclined about 20°. It was cut with parallel faces perpendicular to the line bisecting the two optic axes. Upon looking at the light of a distant lamp through the crystal, and in the direction of one of the optical axes, Professor Lloyd saw a point more luminous than the space immediately about it, and surrounded by something resembling a stellar radiation. Hence the direction of the optical axes may be determined by this modification of common light. When the adjustment was perfected, and the light transmitted in the exact direction of the cusp ray, there appeared at first a luminous circle, with a small dark space in the centre, and in this dark central space were two bright points, separated by a narrow and well-defined dark line. These appearances rapidly changed in shifting the minute aperture next the eye. On examining the emergent cone with a plate of tourmaline, Professor Lloyd was surprised to observe that only one radius of the circular section vanished in a given position of the tourmaline, and that the vanished ray ranged through 360°, while the tourmaline was turned through 180°. Hence it follows that all the rays of the cone are polarised in different planes. On a more attentive examination of this phenomenon, Professor Lloyd discovered the remarkable law, "that the angles between the planes of polarisation of any two rays of the cone is half the angles between the plane containing the rays themselves and the axis." This law he found to be in perfect accordance with the theory.

The verification of the second kind of conical refraction Professor Lloyd found to be more difficult. The angle of the cone of rays which theory indicated, should be seen within the crystal when a single external ray corresponding with a ray refracted along an optical axis, was 1°55′ in arragonite. The external ray was divided into two, but when the critical incidence was gained, after much care in the adjustment, Professor Lloyd "at last saw the two rays spread into a continuous circle, whose diameter was apparently equal to their former interval.

"This phenomenon was exceedingly striking. It looked like a small ring of gold viewed upon a dark ground; and the sudden and almost magical change of the appearance from two luminous points to a perfect luminous ring, contributed not a little to enhance the interest.

"The emergent light, in this experiment, being too faint to be reflected from a screen, I repeated the experiment with the sun's light, and received the emergent cylinder upon a small piece of silver paper. I could detect no sensible difference in the magnitude of the circular sections at different distances from the crystal.

"When the adjustment was perfect, the light of the entire annulus was white, and of equal intensity throughout. But when there was a very slight deviation from the exact position, two opposite quadrants of the circle appeared more faint than the other two, and the two pairs were of complementary colours. The light of the circle was polarised, according to the law which I had before observed in the other case of conical refraction. In this instance, however, the law was anticipated from theory by Professor Hamilton."

In addition to these interesting results, Professor Lloyd has published an account of a new case of interference, in which the experimental exhibition of the fact is much more manageable than in the experiment of two slightly inclined mirrors given by Fresnel. Professor Lloyd causes the light reflected at an angle of 90° from the surface of a single piece of plate glass or a metallic reflector, to interfere with the direct light that passes parallel to the reflecting surface and near it. A screen placed on the other side of the mirror receives the direct and the reflected pencils, which, meeting under a small angle, after having traversed paths differing by a small amount, interfere. Professor Lloyd also received the two pencils upon an eye-piece placed at a short distance from the reflector, and saw a very beautiful system of bands, in every respect similar to one half of the system formed by the two mirrors in Fresnel's experiment.

Professor Lloyd has more recently, in 1836 and 1837, communicated to the Royal Irish Academy the results of his researches,[3] *On the propagation of light in uncrystallised media*. His object was to simplify and develope that part of M. Cauchy's theory, which relates to the propagation of light in an ethereal medium of uniform density, and to extend the same theory to the case of the ether enclosed in uncrystallised substances, taking into account the action of the internal molecules. In the first part of his memoir, Professor Lloyd has given good reason for concluding that the theory in its present form is insufficient to explain the phenomena of light in bodies, and that it becomes necessary to take into account the action of the material molecules. In doing this he limits himself to the comparatively simple case, in which the molecules of the ether and the body are uniformly diffused. In the expression for the velocity of propagation, each term consists of two parts, one of which is due to the action of the ether, and the other to that of the body. "It is not improbable," says Professor Lloyd, "that there may be bodies for which the first or principal term is nearly nothing, the two parts of which it is composed being of opposite signs, and nearly equal. In this case the principal part of the expression for the velocity will be that derived from the second term; and, if that term be taken as an approximate value, it will follow, that the refractive index of the substance must be in the subduplicate ratio of the length of the wave nearly. Now, it is remarkable that this law of dispersion, so unlike any

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[1] The *wave surface* is a geometrical surface employed to determine the direction and the velocity of reflected and refracted rays. It is spherical in a singly refracting medium; a double surface or one of two sheets in a doubly refracting medium; and a surface of three sheets, on the supposition that there is a triple refraction. It has always a centre round which it is symmetrical; and the radii drawn from this centre in different directions represent the velocities of rays to which they are parallel.—*Maccullagh's Irish Trans.* vol. xvii.

[2] *Irish Trans.* vol. xvii p. 136.

[3] *Phil. Trans.* 1830, p. 325, or *Edin. Journal of Science*, N.S., No. viii. p. 259.

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thing observed in transparent media, agrees pretty closely with the results obtained by Sir David Brewster in some of the metals. In all these bodies the refractive index (inferred from the angle of maximum polarization) *increases* with the length of the wave. Its value for the red, mean and blue rays, in silver, are 3·866, 3·271, 2·824, the ratios of the second and third to the first, being ·85 and ·73. According to the law above given, these ratios should be ·88 and ·79.

We are indebted also to Professor Lloyd for an admirable history *Of the progress and present state of physical optics*, published in the *Fourth Report* of the meeting of the British Association, held in Edinburgh ; a history not less characterised by its candour and truth, and absence of all national partiality, than by the profound and accurate knowledge of the subject which it everywhere displays. The only cultivator of physical optics to whom Professor Lloyd has done injustice is himself ; and we are glad of the opportunity which we here enjoy, of giving a brief and imperfect account of his original and valuable researches.

Professor Maccullagh.

It is with no less pleasure that we proceed to give an account of the optical discoveries of another Irish philosopher, who, at an early period of life, has placed himself in a distinguished position both as a mathematician and a natural philosopher. We have already seen that M. Ampère gave a direct demonstration of Fresnel's construction for finding the surface of the wave. His solution, however, was extremely difficult and complicated. Mr. James Maccullagh was led in 1829 to believe, from the simplicity and elegance of the results, that there must be some simpler method of arriving at them, and, upon considering the subject with attention, he was led to a concise demonstration of the same theorem, and of some of the other leading points of Fresnel's theory. He has demonstrated a geometrical construction for finding the magnitude and direction of the elastic force arising from a displacement in any direction, and by his construction, with the aid of a few lemmas, he is immediately led to all the conclusions established by M. Fresnel. The magnitude and direction of this force are represented by means of an ellipsoid, having for its semiaxes the three principal indices of the medium, these axes coinciding in direction with, and being inversely proportional to, the axes of Fresnel's generating ellipsoid.

The properties of the wave surface and its use in determining the directions and velocities of reflected and refracted rays, seem to have been discovered independently by Sir W. Hamilton, M. Cauchy, and Mr. Maccullagh, and in a paper entitled, *Geometrical propositions applied to the wave theory of light*, he has applied the properties of that surface to the geometrical development of the theory of double refraction.

Hitherto the remarkable laws of the double refraction of quartz, developed by the successive labours of Arago, Biot, Fresnel, and Airy, were merely a set of independent facts unconnected by any theory ; but Mr. Maccullagh in a paper *On the laws of the double refraction of quartz*, sent to the Royal Irish Academy, in February 1836, has shewn how they may be explained hypothetically, by introducing differential coefficients of the third order into the equations of vibratory motion.

The theory of the action of the metals upon light having been long among the desiderata of physical optics, Mr. Maccullagh thought that it would be important to represent the phenomena of elliptic polarisation, discovered by Sir David Brewster, by means of empirical formulæ, in a manner analogous to that employed by Fresnel in the case of total reflexion. Mr. Maccullagh has applied his formulæ to steel, and in computing from it the intensity of light reflected when common light is used, he obtained the remarkable result, that the intensity decreases very slowly up to a large angle of incidence (less that 75°), and then increases up to 90°, where there is total reflexion. This result entirely accords with the remarkable fact discovered by Mr. Potter,[2] that the intensity decreases with the angle of incidence as far as 70°. Mr. Maccullagh conceives that experiments alone can decide whether the subsequent increase indicates a real phenomenon, or arises from an error in the empirical formulæ.

Mr. Maccullagh deduces also from his formulæ the phenomenon observed by Mr. Airy in the diamond ; and he has applied it successfully to the phenomena discovered by M. Arago, respecting the rings formed between a transparent and a metallic surface. In this experiment Mr. Maccullagh and Prof. Lloyd have both discovered a curious appearance unnoticed by any other author. Through the last twenty or thirty degrees of incidence, the first dark ring surrounding the central spot, which is comparatively bright, remains constantly of the same magnitude, though the other rings dilate greatly by an increase of incidence.

Hitherto the undulatory theory had been unable to give any explanation of the variation of the polarising angle, when the light was reflected in different azimuths from calcareous spar, and other doubly refracting surfaces. Mr. Maccullagh, however, was induced to exercise his mathematical skill on this interesting subject ; and so early as 1834, he communicated to Professor Lloyd an expression for the angle of polarisation at the surface of crystallised media, when the plane of reflexion coincides with the principal section of Fresnel's ellipsoid ; and he found that the law, which he extended by analogy to all cases, represented with much exactness the observations of Sir David Brewster.[3] In a subsequent paper, *on the laws of reflexion from crystallised surfaces*,[4] he has explained the principles upon which his formula is founded. He was obliged to adopt the view of Cauchy, that the vibrations of polarised light are parallel to its plane of polarisation, and being embarrassed by his third ray, he altered Cauchy's six equations of pressure, so as to make them afford only two rays, and give a law of refraction exactly the same as Fresnel's.

It appears, from a subsequent paper of Mr. Maccullagh's,[5] that M. Seebeck[6] had solved the same problem long before, namely, in the case where the plane of incidence coincides with the principal section of the crystal, and had confirmed its accuracy by experiment. M. Seebeck had also pointed out a defect in Mr. Maccullagh's formulæ, No. 2 and 3, which induced the latter to resume the subject ; and in a new paper read to the Irish Academy on the 9th January 1837, a solution of the following problem is given for the first time :—" Supposing a ray of light, polarised in a given plane, to fall on a doubly refracting crystal, it is required to find the plane of polarisation of the reflected ray, and the proportion between the amplitudes of vibration in the incident, the reflected, and the two refracted rays." The hypotheses employed by our author are these, viz.

1. The density of the ether is the same in all media.
2. The vibrations are parallel to the plane of polarisation.
3. The *vis viva* is preserved.
4. The vibrations are preserved ; that is, the resultant of the incident and reflected vibrations are the same as the resultant of the refracted vibrations. " This theory," says the author, " represents very accurately the experiments of Sir David Brewster and M. Seebeck, on the light reflected in air from a surface of Iceland spar."

We owe also to Mr. Maccullagh some interesting views

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[1] *Irish Transactions*, vol. xvii.
[2] *Edin. Journal of Science*, N. S. No. 4.
[3] Professor Lloyd's *Report on Physical Optics*, in the *Fourth Report of the British Association*, 1834, p. 374, (note).
[4] *Lond. and Edin. Phil. Mag.* vol. viii. p. 103.
[5] *Id.* vol. x. p. 42.
[6] Poggendorff's *Annalen*, 1836, No. 6.

History. respecting the nature of the light transmitted by the diamond and by gold leaf. He conceives that there is a change of phase produced by refraction, as well as by reflexion, from these bodies, the change being different according as the light is polarised in the plane of incidence, or perpendicular to it. If the incident ray, therefore, is polarised in any intermediate plane, the refracted ray should be elliptically polarised, which was found to be the case in gold leaf. He conceived that the same remark explains the appearance of double refraction in specimens of the diamond which give only a single image, and that other precious stones are likely to have similar properties. Our author has obtained a general formula for the difference of phase between the two component portions of the refracted light, one polarised in the plane of incidence, and the other perpendicular to it. He finds from this formula, that the difference of phase, which is nothing at a perpendicular incidence, increases until it becomes equal to the characteristic, at an incidence of 90°; and when the light emerges into air, the difference of phase is doubled. In submitting this formula to the test of experiment, which Mr. Maccullagh has not yet done, it will be requisite to ascertain that the diamond is not composed of strata of different refractive powers.[1]

M. Lamé. M. Lamé, an eminent professor in the Polytechnic School, has recently endeavoured to determine the laws according to which the molecules of ether and of bodies act upon each other. He arrives at the conclusion that "the action of ponderable matter upon the ether varies in the inverse ratio of the square of the distance, and that the elasticity of the ether itself is proportional to its density." He concludes that the retardation of the vibratory motion, in penetrating into a dense body, will be greater the less the length of an undulation; so that the refraction will be greater for the shorter undulations, a result which he regards as the true explanation of dispersion.

"M. Lamé," says Professor Lloyd, "has endeavoured to connect the phenomena of double refraction with an assumed constitution of the ethereal fluid. He takes the case in which the ether is supposed to be distributed round the molecules of the body in confocal ellipsoidal shells; and he concludes that a vibratory movement, propagated from a vacuum into a body so constituted, will be separated, at its entrance, into two component movements, which will advance with different velocities.

"The two component vibrations, he finds, will be at right angles, and parallel to the lines of greatest and least curvature of the elementary ellipsoids. Thus, the bifurcation of a ray of light on entering a crystallised medium, and the opposite polarisation of the two pencils, are found to be consistent with a molecular constitution such as that described.

"These results are of the highest interest, and will, no doubt, receive an early examination from those engaged in the same department of analysis. Their author seems to be persuaded that his methods will lead him to the mathematical laws of other phenomena, which he conceives to depend, in like manner, on the motions of the ethereal fluid."[2]

In a memoir more recently communicated to the Academy of Sciences, M. Lamé has sought to determine the mode of vibration of the ethereal particles which surround the material molecules in concentric spherical shells of decreasing density. He considers transparent homogeneous bodies as consisting of a multitude of such molecules, distributed uniformly in space, and at distances incomparably greater than their diameter; and he conceives that the waves propagated from the molecules adjoining to the surface of emergence, will produce by interference phenomena resembling the fixed lines in the spectrum.[3] This opinion, however, is in our opinion, incompatible with the actual phenomena of fixed lines.

Introduction. The narrowness of our limits will not permit us to record in this historical sketch many other discoveries which have been recently given to the world, though many of them will be detailed under the heads to which they respectively belong. These discoveries have been made principally by Mr. H. F. Talbot, Mr. Potter, Mr. Dove, and other philosophers.

Having thus given a condensed sketch of the history of optical discovery, from the earliest to the present times, we shall now proceed to the proper subject of this article. As the nature of this work requires that the subject be treated in a very popular manner, we shall pass briefly over those branches of Optics which are generally treated mathematically, and which occupy a prominent part in all ordinary treatises, and occupy our limited space with the more interesting departments of Chromatics, Physical Optics, the Double Refraction and Polarisation of Light, the Explanation of Natural Phenomena, the Laws of Vision, and the Construction of Optical Instruments.

INTRODUCTION.

The ancients confounded the phenomena of vision with those of light, by supposing that when we see external objects something passes from the eye to the object. The phenomena of light, however, are totally independent of those of vision, and have a real existence in nature, whether we suppose them to be objects of vision or not.

1. Light is the element by means of which we see external bodies. These bodies may be divided, in reference to light, into two classes, *self-luminous* and *non-luminous*, or dark bodies. The first class include the sun, the stars, flames of all kinds, and bodies which become luminous by friction, heat, and electrical and magnetical action. Such bodies become visible by the light which they themselves emit, and we then obtain a knowledge of their apparent form. The sun, for example, is seen to be round, and the flame of a candle to be of a conical shape. The second class of bodies, however, are never visible but when placed in the light of self-luminous bodies. It includes the moon and all the primary and secondary planets, of which we see only those portions upon which the sun's light directly falls, and all the other objects upon our own globe. When we bring a lighted candle into a room its light falls upon all the objects in the apartment, and they become visible. These bodies reflect or throw back the light of the candle, and they scatter it in all directions, because they are, generally speaking, visible, wherever we place our eye. But objects also become visible by the light thrown off by non-luminous. When the moon has the form of a sharp crescent, we see the obscure part of its circular disc by the light thrown upon it from the earth, which is at that time almost fully illuminated by the sun. In like manner in the room lighted with a candle, objects are seen in corners and places upon which the light of the candle does not fall. These objects, however, are illuminated by the light of the candle thrown back by the white ceiling and walls of the apartment; and hence the reason why the ceilings and apartments should always be white, and why the walls should be white if we wish to obtain the greatest quantity of light from a given flame. Light.

2. The light thrown off from all bodies whether self-luminous or non-luminous, is of the same colour as themselves. A red hot body, or a stick of red sealing wax, will make a sheet of white paper appear red if held near them.

3. But though coloured bodies throw off light of the same colour with themselves, bodies do not appear of the same colour as that of the light which falls upon them. All

[1] See page 27.

[2] See Professor Lloyd's *Report*, p. 303.

[3] *Id. Id.* (note), and *Ann. de Chimie*, tom. lvii.

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bodies which are white in white light, appear of the same colour as that of the light which falls upon them; but other bodies, such as red wax, appear red even in white light, a property which they derive from a peculiar structure acting upon the different colours of which white light is composed. Bodies of this kind when illuminated with lights of different colours, always appear brightest in light of the same colour which they exhibit in white light. Thus a stick of yellow wax is more luminous than a stick of red wax, but the yellow wax will be less luminous than the red wax if we illuminate them both with red light.

4. Bodies in their relation to light, are divided into two classes, *opaque* and *transparent.* An *opaque* body is one that stops the light that falls upon it, such as a piece of coal, or a plate of silver; and a *transparent* body is one which transmits the light through it, such as glass, water, and air. The most opaque body, however, may be made transparent by making it sufficiently thin, and the most transparent one may become opaque by making it sufficiently thick.

5. The opacity of bodies, or their power of intercepting light, gives rise to what is called the *shadows* of bodies. As the shadows of bodies are of the same size as the bodies, we thence deduce the fundamental optical fact, *that light moves in straight lines.* The same fact may be proved in a thousand ways, but most simply by placing three small holes in a straight line. In this case the light will pass through them, but if any one of them deviates from the straight line, the light will be stopped. The same thing is finely seen without any experiment, by admitting light into a dark room through an aperture of an inch wide. Its path, marked out by the floating dust which it illuminates, will be seen to be a straight line.

6. Light issues or radiates in every direction and from every point in the surface of luminous and visible bodies. This fact is proved by the circumstance, that we see such bodies wherever we place our eye. However much we may magnify the bright part of the sun's disc through a telescope, or a sheet of white paper through a microscope, we shall never see any points destitute of light.

7. Light consists of separate and independent *parts*, which, when reduced to the smallest magnitude, are called *rays of light.* A beam of light transmitted into a dark room may be actually divided into smaller portions in a variety of ways. The smallest portion that we can allow to pass may be called a ray of light, and possesses the same properties as the larger beam.

8. *Light moves at the rate of* 192,000 *miles in a second.* This extraordinary property of light has been deduced by direct calculation from the immersions and emersions, in eclipses of Jupiter's satellites, which become visible to us nearly a quarter of an hour earlier when the earth is nearest Jupiter, than when it is farthest from that planet. The exact velocity of light obtained in this manner, is 192,500 miles in a second; whereas, Dr. Brinkley and M. Struve have found it to be 191,515 miles in a second, from the phenomena of aberration.[1] This last determination is undoubtedly the most correct. The mean, however, of 192,000 is most easily remembered.

The velocity with which light travels is so inconceivable, that we require to make it intelligible by some illustrations.

It moves from the sun to the earth in $7\frac{1}{2}$ minutes, whereas a cannon ball fired from the earth, would require *seventeen years* to reach the sun.

Light moves through a space equal to the circumference of the earth, or about 25,000 miles in about the 8th part of a second. The swiftest bird would require *three weeks* to perform this journey.

Light would *demonstrably* require *five years* to move from the *nearest* fixed star to the earth, and *probably* many thousand years from the most remote star seen by the telescope. Hence if a remote visible star had been created at the time of the creation of man, it may not yet have become visible to our system.

9. When light falls upon any body, whether rough or smooth, coloured or uncoloured, a part of the incident light enters the body, and is either lost within it, or transmitted through it; and part of it is reflected from its surface, either in the same or in a different direction from that in which it came. The light which enters the body and is lost, the light which is transmitted through the body, and the light which is reflected from it, suffer certain changes in its direction, and in its physical properties. It belongs to the *geometrical* or mathematical part of optics, to assign the laws which regulate the change of direction which light experiences when it is transmitted through, or reflected from bodies, whose density is uniform, and whose surfaces have a geometrical form; and to *physical* optics, to explain the changes in the physical properties which light acquires in passing through bodies, in passing near them, or in being reflected from their surfaces.

The laws or rules which regulate the reflexion of light, constitute that branch of optics which is called *catoptrics*, and the laws which regulate the changes of deviation which light experiences when transmitted through bodies, is called *dioptrics.*

PART I. CATOPTRICS, OR THE REFLEXION OF LIGHT.

Catop-

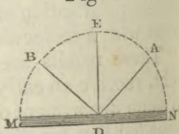
The word *catoptrics*, derived from the Greek words κατα *from*, and ὀπτομαι, *to see*, signifies that department of optics which treats of the reflexion of light from the polished and regularly formed surfaces of bodies, such as *water*, *glass*, and the *metals.*

The name of *speculum* or *mirror*, has commonly been given to bodies that have regularly formed and highly polished surfaces. The word *speculum* is generally applied to polished metals, and *mirrors* to reflectors made of glass and covered with an amalgam of tin and mercury, to increase their power of reflecting light.

There are four kinds of specula used in optics, namely, *plane*, *convex*, *concave*, and *cylindrical*, and when light falls upon any of these specula, which we shall always consider to be formed of polished metal, it is reflected according to the same law.

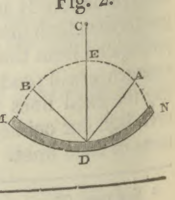
General Law of Reflexion.

Fig. 1.



Let AD be a ray of light which falls upon a *plane speculum* MN, and strikes it at the point D, this ray will be driven back in the direction DB, so inclined to the original ray AD that if we raise from the point D a line DE perpendicular to MN, the angle BDE will be equal to the angle ADE. The ray AD is called the *incident* ray, DB the *reflected* ray, ADE the *angle of incidence*, and BDE the *angle of reflexion.* The two rays AD, DB, and the perpendicular DE, all lie in the same plane AEBD. This plane is sometimes called the *plane of incidence*, and sometimes the *plane of reflexion*,, and it is always at right angles to the reflecting surface MN.

Fig. 2.



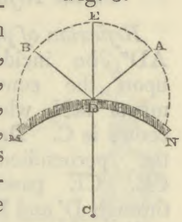
When the reflecting surface is *concave* as MN in fig. 2, and is part of a sphere, whose centre is C, a ray of light AD falling upon any point D, will be reflected in a direction D B, so as to form the same angle BDC with a line CD drawn from the cen-

[1] See ABERRATION, vol. i. p. 31.

tre of the sphere to the point of incidence D, that the incident ray AD does, viz. the angle ADC. In this case the line DC is perpendicular to the reflecting surface at D.

When the speculum is *convex* as in fig. 3, and C the centre of its spherical surface, then if we draw CE, passing through any point D, of the spherical surface MN, any ray of light AD, incident at D, will, after reflection, take a direction DB, having the same inclination BDE to DE, that the incident ray AD has. In this case, also, the prolonged radius of curvature CE, is perpendicular to the surface MN at D.

Fig. 3.



When the surface is cylindrical, the form of the reflecting line, or the line lying in the plane of reflexion, is a circle in one direction, a straight line in another, and an ellipse in all intermediate ones, but in every case the reflected ray will take such a direction that the angle which it forms with a line perpendicular to a plane touching the cylinder at the point where the ray strikes it, will be equal to the angle which the incident ray forms with the same perpendicular. This is true of all curved surfaces whatever.

The results now stated have been established by direct experiment for all inclinations of the incident ray, so that it is a law universally true, that in the reflexion of light *the angle of incidence is equal to the angle of reflexion.* Hence it follows, that when the incident ray is perpendicular to any surface, it is reflected back in the direction in which it came, and when the incident ray is parallel to the reflecting surface, (when plane) or is inclined 90° to it, it will pass on without suffering any change in its direction.

The equality of the angles of incidence and reflexion is finely seen in the game of Billiards, in the reflexion of a hand-ball from a wall, and in the reflexion of sound.

By means of the law of reflection we can easily determine, even without any calculation, the effects produced upon light by specula and mirrors, and the shape, and magnitude, and position of the images of all objects seen by reflexion from them. These effects we shall now proceed to consider in their order.

Definitions. *Parallel rays* are those which are parallel or equidistant, as AD, A′D′, fig. 4.

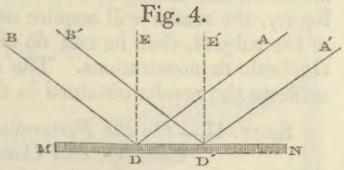
Diverging rays, are those which issue or diverge from a point, and separate from each other, forming an angle as AD, AD′, AD″, fig. 5.

Converging rays, are those which *converge* to a point, or approach to one another, as AD, A′D′, A″D″, fig. 6.

Sect. I.—*On the Reflexion of rays from Plane Mirrors.*

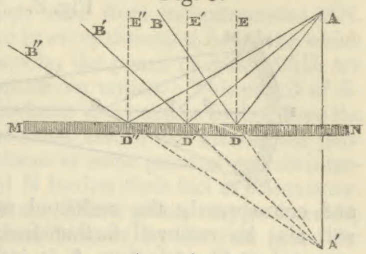
Reflexion of parallel rays. When parallel rays AD, A′D′ fall upon a plane speculum MN at the points D, D′ they will preserve their parallelism after reflexion. Drawing the perpendiculars DE, D′E, make the angles of reflexion EDB, E′D′B′ equal to the angles of incidence ADE, A′D′E′, and it will be found that DB is parallel to D′B′. If the space between AD, A′D′ be supposed to be filled up with other rays parallel to AD, the space between DB and D′B′ will also be filled up with parallel rays. Hence a beam of parallel rays ADD′A′, will be reflected into the parallel beam DB D′B′, the latter being the same as the former but inverted. If the inverted beam suffers another reflexion from another mirror, parallel to MN, it will be restored to a position exactly parallel to AA′DD′, and no longer inverted.

Fig. 4.



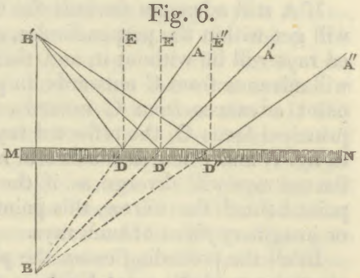
Reflexion of diverging rays. When diverging rays, AD, A′D′, A″D″, fall upon a speculum MN, they will be reflected in directions DB, D′B′, D″B″ found by making the angles BDE, B′D′E, B″D″E″ respectively equal to ADE, A′D′E′, A″D″ E″, and the reflected rays being continued back till they meet, they will be found to meet at a point A′ so that the line AA′ is at right angles to MN, and AN equal to A′N. Hence the rays will have the same divergency after reflexion, as before it, and as if they came from A′, the reflected beam being inverted, as in the preceding case.

Fig. 5.



Reflexion of converging rays. When converging rays AD, A′D′, A″D″, fall upon a speculum MN, they will converge after reflexion to a point B′, so situated, that if BB′ is at right angles to MN, B′M will be equal to BM. The reflected rays DB, D′B, D″B″, will be found by making the angles EDB′ E′D′B′, E″D″B″, respectively, equal to the angles of incidence, ADE, A′D′E,′ A″D″E″.

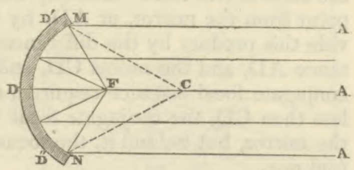
Fig. 6.



On the Reflexion of Rays from Concave Mirrors.

Reflexion of parallel rays. Let MN be a *concave* mirror whose centre of concavity is C, and let parallel rays AD, AD′, A″D″, fall upon the mirror, the central ray AD passing through the centre C. From C draw the lines CD′, CD″. Then since CD′ is perpendicular to the mirror at D′, the ray AD′ will be reflected in the same direction D′F, so that the angle of reflexion CD′F is equal to the angle of incidence AD′F. In like manner, the ray AD will be reflected to E, and the central ray AD will be reflected back to F also; all intermediate rays being likewise reflected to F.

Fig. 7.

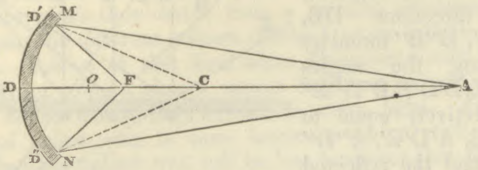


If the curvature of MN is not deep, and if the points D′,D″ are taken near D, it will be found by making the angles of reflexion equal to the angles of incidence, that the rays all meet accurately at F, which is called the *focus* of the mirror for parallel rays, or its *principal* focus. This *focus* is in all mirrors exactly half-way between the centre C, and the surface of the mirror.

The point F derives its name of *focus* from its being the burning point of a mirror, or the point where the parallel rays, issuing from the sun are most condensed, and therefore occasion the most powerful heat.

Reflexion of diverging rays. Let AD, AD′ AD″, be diverging rays issuing from A and falling upon the mirror MN, whose centre is C, and principal focus O. Then if we make the angles of reflexion equal to the angles of incidence, as in the last case, we shall find that the rays will be reflected to a point F, between the centre C of the mirror, and its principal focus O. If the radiant point A is removed from the mirror, and the rays fall on the same points of it, it is manifest that the incident rays will be removed farther from the perpendiculars CD′, CD″,

Fig. 8.



and consequently the reflected rays which meet at F, will also be removed farther from them. Hence F will approach to O, and when A is infinitely distant, and the rays parallel, F will coincide with O. But if A approaches to the mirror, the incident rays will approach to the perpendiculars, and as the reflected rays will do the same, their point of concourse F will approach to C. When A reaches C, the focus F will also reach C, and the reflected ray will coincide with the incident ray.

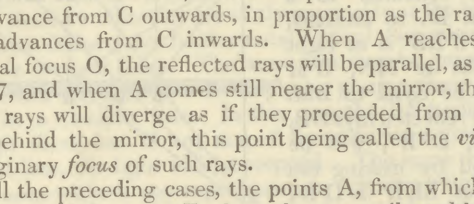
If A still advances towards the mirror, the incident rays will get within the perpendicular, and therefore the reflected rays will be without it, and their point of concourse F will advance from C outwards, in proportion as the radiant point advances from C inwards. When A reaches the principal focus O, the reflected rays will be parallel, as seen in fig. 7, and when A comes still nearer the mirror, the reflected rays will diverge as if they proceeded from some point behind the mirror, this point being called the *virtual* or imaginary *focus* of such rays.

In all the preceding cases, the points A, from which the rays issue, and the point F where they are collected by reflection, are called *conjugate foci,* because if we make A the radiant point, F will be the focus, if we make F the radiant point, A will be the focus.

The conjugate foci of a concave mirror may be easily found by projection. The following rule will give the focus more accurately when the rays AD′, AD″ are not far from the central one AD. Multiply the distance of the radiant point from the mirror, or AD, by the radius CD, and divide this product by the difference between double the distance AD, and the radius CD, and the quotient will be the conjugate focal distance required, or FD. If twice AD is less than CD, the conjugate focal point will not be before the mirror, but behind it, the focus being in that case a virtual one.

Reflexion of converging rays. Let AD, AD′ AD″ be

Fig. 9.



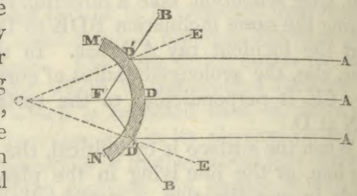
rays converging to a point a behind the mirror MN, whose centre is C. Having drawn CD′ and CD″, make the angles of reflection CD′f, CD″f respectively equal to the angles of incidence AD′C, AD″ C; and D′f, D″f will be the reflected rays having their focus at f, between the mirror and its principal focus F. If the point of convergence a of the rays, or the conjugate focus, approaches to the mirror, the other conjugate focus f will also approach to it, and if it recedes from the mirror, the focus f will also recede, reaching F when a is infinitely distant, in which case AD′, AD″ are parallel, as in Fig. 7. The following is the rule for finding the conjugate foci when one of them is given:

Multiply the distance of the point of convergence from the mirror, or aD by the radius of the mirror or CD, and divide this product by the sum of double the distance aD and the radius CD, and the quotient will be the conjugate focal distance required, namely, fD, the focus f being in front of the mirror.

On the Reflexion of Rays from Convex Mirrors.

Reflexion of parallel rays. Let parallel rays AD, AD′, AD″ be incident upon the convex mirror MN, whose centre is C. Draw the perpendicular CE, CE passing through D′ and D″, and making the angles of reflection EDB, ED″B equal to the angles of incidence, AD′E, AD″E, the reflected rays will be D′B′ D″B, whose virtual focus F is behind the mirror, and so situated that FD is equal to FC.

Fig. 10.



Reflexion of diverging rays. If we suppose the rays AAA to diverge from any point in the line or axis AD, they will recede from CE, CE, consequently the reflected rays D′B, D″B will recede also; that is, will become more divergent, as if they came from a focus between F and D, the virtual focus approaching to D as the radiant point A approaches to D.

Reflexion of converging rays. In like manner, if the rays AAA widen at A, that is, converge to some point behind the mirror MN, they will approach to CE and CE, so that the reflected rays D′B, D′ B will also approach to CE, and consequently diverge less, or have their virtual focus between F and C. When the converging rays coincide with CE, CE, they will be reflected back in the direction in which they came, having C for their virtual focus. When the converging rays pass CE, the reflected rays will also pass to the opposite side, and converge less after reflexion, having their virtual focus beyond C. When they converge to F, the reflected rays will be parallel as in fig. 10, where we may suppose BD′ BD″ the incident, and D′A, D″A the reflected rays. When the rays converge to a point between F and D, the reflected rays will converge to a point in the axis, and as the point of convergency of the incident rays approaches to it on the one side, the point of convergency of the reflected rays will approach to it on the other.

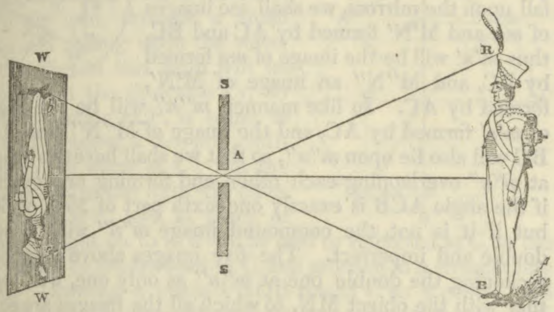
It would have been easy by the simplest elements of geometry, to have demonstrated the preceding truths; but the demonstration would have been rigorous only when the rays fell upon the mirror at points infinitely near D in the axis AD. By finding from projection the foci of rays of all kinds, and falling upon the mirror at all degrees of obliquity, the reader will acquire more substantial knowledge of the subject, than he can do either from geometrical or algebraic demonstrations. The same observation is applicable to the results obtained in the following section.

Sect. II.—*On the Formation of Images by Plane, Concave, and Convex Mirrors.*

Formation of Images by Apertures.—In optics an image is a luminous resemblance or picture of any object whatever, formed either on a white ground, such as a sheet of paper, or suspended in the air.

In order to understand how images are formed, let us suppose that a soldier is standing on the outside of an open window, with a *red coat* and *blue trowsers,* strongly illuminated by the sun. The white wall opposite the window is illuminated by all the light which enters the window, the blue light of the sky, the green foliage, the red coat, and the blue trousers, so that it has no distinct colour, but a mixture of all these. If we close the shutters, so as to allow no light to fall upon the wall but the red light of the coat, and the blue light of the trowsers, it will be illuminated only by a mixture of red and blue light. But if we close all the shutters SS, and leave only a small hole A, about half an

Fig. 11.

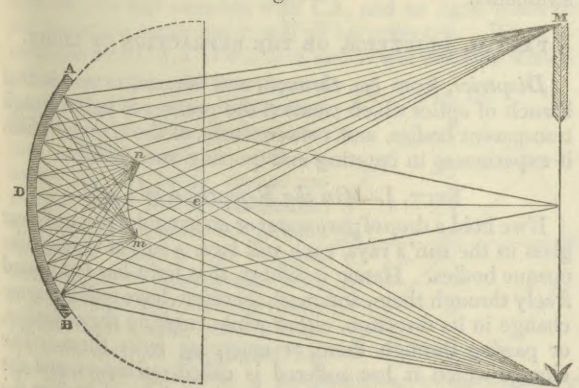


inch in diameter, then it is obvious that the *red* rays at and below R, passing through the hole A, will illuminate the opposite wall at and above *r* with *red* light, and the *blue* rays the opposite point at and below *b* with *blue* light; and that no *red* light can fall upon *b*, and no *blue* light upon *r*. Hence we shall have the *red* body of the soldier rudely shadowed out at and above *r*, and his *blue* legs at and below *b*, this small image being inverted, because the rays from the upper part of his body fall upon the lower part of the wall, and the rays from the lower part of his body upon the upper part of the wall. If we make the hole A smaller and smaller, the inverted image of the soldier will become more and more distinct, the colours will be better separated, and the picture may be made so distinct, that the features of the individual could be recognised. Now this separation of the various lights that at first fell upon the wall is effected solely by diminishing the aperture through which they pass, for if the aperture is exceedingly small, then as no two rays can proceed from the same point, they cannot fall upon or illuminate the same point, and hence each point of the object is represented on the wall by the colour of the light which it throws out.

As the coloured rays from the soldier are thrown off in all directions, an inverted image of that soldier may be formed in any part of space, by excluding all the other rays except those which pass through a small aperture. It is manifest, from a simple inspection of fig. 11, that the size of the inverted image will diminish not only with the distance of the aperture from the soldier, but also with the distance of the ground WW from the aperture.

Formation of Images by Concave Mirrors.—The effect of a concave mirror in forming an image is the same as that of an aperture; but it produces a finer effect, and acts upon a different principle.

Fig. 12.

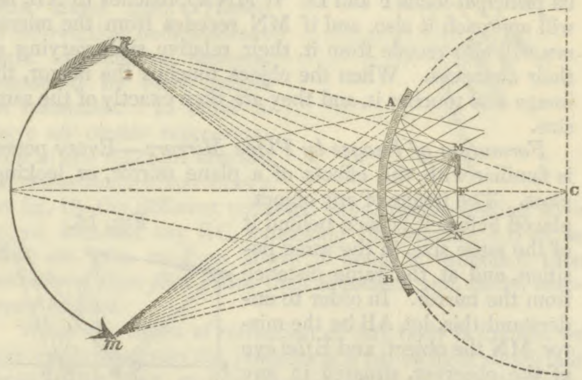


Let AB, fig. 12, be a concave mirror, C its centre, and MN an object placed before it. Of all the rays which flow from every part of this object in every direction, we shall consider only those which issue from its extremities MN. The rays from M radiate in every direction, but those which fall upon the mirror, namely, the pencil or cone MAB, are the only ones which require our notice. This pencil of diverging rays will have its focus at a point *m* farther from the mirror than its principal focus, and in like manner the pencil NAB will have its focus at some point *n*, pencils intermediate between M and N having their foci at points intermediate between *m* and *n*. These points may be found by projection, as already described, or by the rule given for diverging rays.

The image *mn* is obviously an inverted picture of the object MN, and its size is to that of the object as the distance of the image from the mirror is to the distance of the object from it, that is, as *n*A is to NA, as may be found from projection, or from an experimental measurement of the distance, when a mirror is actually used.

From the doctrine of reflected diverging rays it follows, and may be proved by projection, that as the object MN approaches to the mirror, the image *mn* will recede from the mirror, till the object and image meet one another at the centre C, where they will have the same size. If MN still moves towards the mirror within C, the image *mn* will move outwards beyond C, and the image will now be larger than the object. If the object comes to the place *mn*, and is of the same size as *mn*, the image of it will be formed at MN, and will have the same size as MN. If the object goes still nearer the mirror the image will go still farther off than MN, increasing in size. When the object reaches the principal focus half way between C and D, the image will be infinitely distant; and when the object goes still nearer the mirror, as in fig. 13, where it is placed at MN, between the principal focus

Fig. 13.



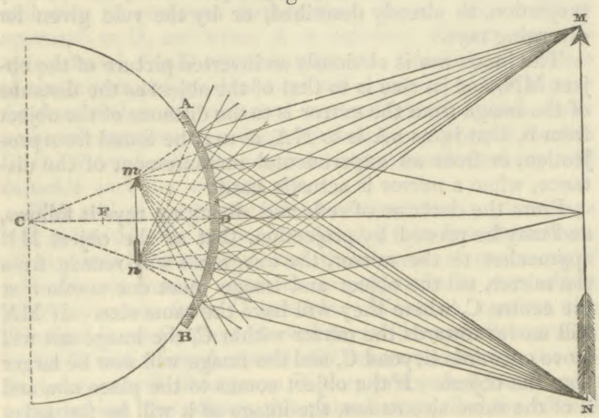
F and the mirror AB, the rays will diverge in front of the mirror, and form an inverted *virtual image*, *mn*, behind the mirror. As the image MN approaches the mirror, the virtual image *mn* also approaches to it.

If we take a concave mirror of some size, and place before it any highly luminous or strongly illuminated object, such as a plaster of Paris cast, we may obtain an interesting experimental proof of the preceding results. When the image is formed in front of the mirror, it will appear suspended in the air, and the effect of this will be greatly heightened if it is received on a cloud of thin blue smoke raised from a chafing dish below the place of the image. By considering that as the object moves from MN to C, fig. 12, the image *mn* advances to C, we obtain an explanation of the celebrated experiment with the dagger mentioned by John Dee, in our history of the science, in which a person with a drawn dagger striking at the mirror is met by another person, viz., his own image, returning the stroke.

If the object MN is the sun, a small image of his disc will be formed at *mn*, in which are collected all the rays of light which fall upon the surface of the mirror. It will therefore have such a degree of heat as to melt even the hardest gems and metals. Such a mirror is called a burning mirror, from its effects.

Formation of Images by Convex Mirrors.—As convex mirrors often form a part of household furniture, we are more familiar with their properties. They always form *erect* images of objects, which appear at a distance behind them.

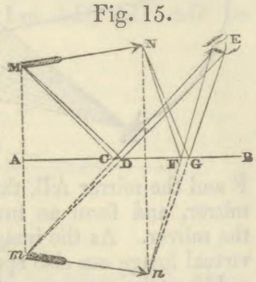
Fig. 14.



If AB is a convex mirror whose centre is C, and principal focus F, and MN an object placed before it, it is obvious, from our description of fig. 10, that the diverging pencils MAB, NBA, will diverge more after reflexion, as if they came from virtual foci *mn* behind the mirror, so that our eye receiving such diverging rays will see an erect image *mn* of the object MN placed behind the mirror, and between its principal focus F and D. If MN approaches to AB, *mn* will approach it also, and if MN recedes from the mirror, *mn* will also recede from it, their relative sizes varying as their distances. When the object touches the mirror, the image also touches it, and they are then exactly of the same size.

Formation of Images by Plane Mirrors.—Every person is familiar with the effects of a plane mirror, or looking-glass. The image of any object placed before it is seen behind it of the same size, in the same position, and at the same distance from the mirror. In order to understand this, let AB be the mirror, MN the object, and E the eye of the observer, situated in any given position. Rays from M and N fall upon every part of the mirror, but MC, MD are the only ones from M which can reach the eye E, as all the rest are reflected either above or below the eye E. In like manner, the rays NF, NG are the only ones from N which can enter the eye. The extremity M of the object will therefore be seen in the direction E*m*, and the concourse or virtual focus of the reflected rays will, as shewn in fig. 6, be at a point *m*, so situated, that if MA*m* is at right angles to the mirror, A*m* will be equal to AM. For the same reason, the point N will be seen at *n*, as far behind the mirror as N is before it; and it is obvious, from the parallelism of M*m* and N*n*, and the equality of the distance of M, *m*, and N, *n* from AB, that *mn* is equal to MN.

Fig. 15.



If two plane mirrors are inclined to each other, as AC, B, fig. 16, and an object MN placed between them, an eye situated so as to receive the reflected rays, will see a series of images of MN all arranged symmetrically. Behind AC, for example, an image *mn* will be formed, and behind BC another image M′N′. But as the rays which form these images again fall upon the mirrors, we shall see images of *mn* and M′N′ formed by AC and BC, thus *m′n′* will be the image of *mn* formed by BC, and M″N″ an image of M′N′, formed by AC. In like manner, *m″n″* will be the image of *m′n′* formed by AC, and the image of M″N″ formed by BC will also lie upon *m″n″*, so that we shall have two images at *m″n″* overlapping each other, and forming one exactly, if the angle ACB is exactly one-sixth part of 360°, or 60°; but if it is not, the compound image *m″n″* will be seen double and imperfect. The five images above described, reckoning the double one at *m″n″* as only one, will, together with the object MN, to which all the images are equal and similar, constitute a perfect equilateral triangle, so that if MN is a coloured and an irregular object, the symmetrical figure composed by it, and all its images, will be highly beautiful and agreeable to the eye. If MN, in place of being perpendicular to the mirror BC, had been inclined to it, no pair of images would have formed a straight line, as in the figure, and the combination would have been more beautiful. This is the principle of the *Kaleidoscope*, in as far as the multiplication and arrangement of the images is concerned; but this instrument has already been so admirably described by an eminent writer, in our article KALEIDOSCOPE, that we must refer the reader to it for farther information.

Fig. 16.

Formation of Images by Cylindrical Mirrors.—It is not easy, in a diagram, to represent the progress of rays in the formation of an image by a cylindrical mirror. As a cylinder is in one direction a plane mirror, in another a convex mirror, and in all others an elliptical one, the eccentricity of the ellipse passing through all degrees, from a circle to a straight line, different parts of a regular figure presented to such a mirror will appear of different sizes, and at different distances behind it. Part of the figure will have the same form and position as in a plane mirror, part as in a convex mirror, and the other parts of the image will have intermediate sizes and positions. Hence the image will be completely distorted. If the mirror is placed horizontally, the human face will appear of the right size from ear to ear, but contracted, as in a convex speculum, from brow to chin. Hence, if a distorted picture is properly drawn, and properly presented to the mirror, that is, if the cylinder is placed vertically before the picture, the image of the distorted picture will be rectified; the length between the ears will be contracted into the same proportional size as the shortness between the brow and the chin, and their shortness will remain unaffected. Such a distorted picture will be afterwards represented in the part of this article on Optical Instruments.

PART II. DIOPTRICS, OR THE REFRACTION OF LIGHT.

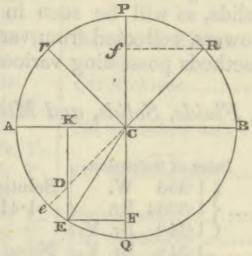
Dioptrics, from δια, *through*, and ὀπτομαι, *to see*, is that branch of optics which treats of the passage of light *through* transparent bodies, and, consequently, of the changes which it experiences in entering and quitting such bodies.

SECT. I.—*On the Refraction of Light.*

If we hold a drop of pure water or an irregular piece of clear glass in the sun's rays, each will have a sort of shadow like opaque bodies. Hence it follows, that light has not passed freely through them, and must, therefore, have suffered some change in its direction, either while entering these bodies, or passing through them, or emerging from them. The change which it has suffered is called *refraction*, and the nature of this change will be discovered by observing the effects produced upon light by transparent bodies, whose surface is flat and regular.

For this purpose let AB, fig. 17, be the surface of *water* in a vessel, and RC a ray or pencil of light proceeding from a candle or from the sun, through a small hole, and falling upon the water at C. Part of this light will be *reflected* in the direction C*r*, so that the angle *r*CP, is equal to RCP, PQ being a line perpendicular to the water at C; but the greater part of the light will enter the water at C, and in place of going straight on to *e*, it will be *bent* or refracted at C, or the ray R*e* will be *broken back* at C, and proceed in a straight line to E. Drawing a circle PAQB round C as a centre, and from the point E, where the refracted ray cuts it, drawing EK parallel to PQ, it was found by Snellius that CD was to CE or C*e* as 3 to 4, and we have shewn in the history of optics, that if R*f* and EF are drawn perpendicular to PQ, CD is to C*e* as EF is to R*f*. But R*f* is the sine of the *angle of incidence* RCP, and EF is the sine of the angle ECQ, which is called the *angle of refraction*. Now, Snellius discovered by numerous experiments, that whatever was the magnitude of the angle of incidence RCP, the magnitude of the angle of refraction was such that CD was to C*e* as 3 to 4, or in a constant ratio. Hence it follows, that the sines of the angles of incidence and refraction R*f* and EF, are in the case of water in the constant ratio of 4 to 3.

Fig. 17.

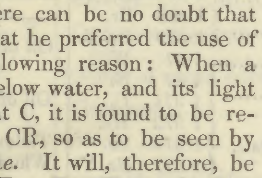


Snellius in his manuscripts did not mention the *constant ratio of the sines*, but merely the *constant ratio of CD and Ce*, which is the same. The ratio of the sines was first mentioned by Descartes, but there can be no doubt that Snellius knew it perfectly, and that he preferred the use of the ratio of CD to C*e*, for the following reason: When a luminous body is placed at E below water, and its light passes through a small aperture at C, it is found to be refracted or bent into the direction CR, so as to be seen by an eye at R, in the direction R*e*. It will, therefore, be seen, as it were, elevated from E to D. Hence Snellius preferred giving the law of this elevation, to any other law not connected with the phenomena.

As the incident ray RC approaches to the perpendicular PQ, the refracted ray CE approaches also to the perpendicular, and CD becomes less and less, and when RC coincides with PC, or when the ray is incident perpendicularly, the refracted ray CE will coincide with CQ, or the incident ray will suffer no refraction at C. When the angle of incidence RCP increases, and RC approaches to the surface of the water CB, the angle of refraction ECQ will also increase, the line CD will increase, and the refracted ray approach also to the surface CA, and when RC coincides with BC, C*e* will coincide with CA, and no light whatever will enter the water but it will all be reflected. When C*e* coincides with CA, CD will be 3, and D will coincide with K.

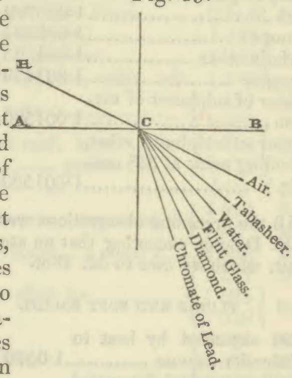
Such are the phenomena and law of refraction when light passes from a rare medium such as *air*, into a dense medium such as *water*, the ray being always *refracted from* the perpendicular, according to the fixed law already described. Let us now suppose, that the ray of light passes from a dense medium, such as water placed above AB, into a rare medium, such as air placed below AB, and let PQ be a perpendicular to the surface of the water at C. It is found by experiment that the ray neither goes straight on to *e*, nor is refracted towards the perpendicular as before, but is refracted from the perpendicular into the direction CE, so that if the line KED is drawn through E, parallel to PQ, and cutting the original direction of the ray R*e* prolonged, in the point D, CD will be to CE or C*e* as 4 to 3, and in a constant ratio, or R*f* the sine of the angle of incidence will be to EF the sine of the angle of refraction in the constant ratio of 4 to 3. When the ray RC coincides with PC, so that the angle of incidence is nothing, the angle of refraction will also be nothing, and the refracted ray CE will coincide with CQ, the incident ray having gone straight on without experiencing any refraction; but when the angle of incidence increases, and RC approaches towards BC, the refracted ray CE will approach to CA, which it will reach long before R reaches B. When CE reaches CA, the ray RC will no longer emerge from the water into the air, but will suffer what is called *total reflexion* at C, and at every angle of incidence beyond that at which this total reflexion commences, the light will continue to be totally reflected till RC coincides with RB.

Fig. 18.



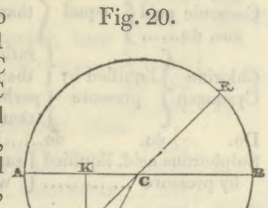
If we repeat all the above experiments with *plate* or *crown glass*, in place of *water*, we shall find the very same phenomena reproduced, with this difference only, that the constant ratio of CD to C*e*, or of the sines R*f* to EF, in place of being as 3 to 4 in one case, (see fig. 17,) and 4 to 3 in the other (see fig. 18,) will be as 2 to 3, and as 3 to 2, or in the case of water the ratio will be as 1 to 1·333, and in glass as 1 to 1·500. The number 1·333 is called the *index of refraction* for *water*, and 1·500 the *index of refraction* for *glass*. In like manner it is found that the index of refraction for *tabasheer* is 1·111, being less than that for water; for flint glass 1·600, for diamond 2·500, and for chromate of lead about 3·00. Hence it follows, that bodies refract light in different degrees, measured by their indices of refraction. In order to have an ocular representation of the different degrees of refraction, we have drawn in fig. 19, the different refracted rays, corresponding to a given incident ray RC, supposing the surface AB to be first *air*, (the medium above it being a vacuum), then *tabasheer*, then *flint glass*, then *diamond*, and, lastly, *chromate of lead*.

Fig. 19.



When the index of refraction of any body is known, we can easily ascertain the progress of a ray of light which falls upon such a body, and its direction after quitting the body. The following example of this we shall give for plate glass. Let AB be the surface of a piece of plate glass whose index or ratio of refraction is as 2 to 3, or as 1 to 1·50, and let a ray of light RC fall upon it at C. Prolong RC to *e*, and upon a scale of equal parts take in the compasses CD, equal to 10 of these parts, and C*e* equal to 15, or CD equal to 2, and C*e* to 3 parts. Upon C as a centre with the radius C*e* describe the semicircle A*e*B, and through D draw KDE, perpendicular to AB, and meeting the semicircle in E, join CE, and CE will be the refracted ray. When the ray passes from a denser to a rarer medium, as in fig. 18, C*e* is made equal to 10, and CD to 15, and DK being drawn perpendicular to AB, and a line

Fig. 20.



drawn from C to the point E, where DK cuts the circle, CE will be the refracted ray. This method, which is obviously much more simple and elegant than when we use the sines of the angles, is, so far as we know, new, and we shall use it in future for determining the place of the refracted ray. It is obvious, that when D and K coincide with A, fig. 18, DK becomes a tangent to the circle at A, and the light suffers total reflexion.

If the preceding experiments are repeated with various solids and fluids, it will be found, that the same law of refraction takes place with all of them, the index of refraction varying more or less in each, the refractive power being least in the gases, and less in fluids, generally speaking, than in solids, as will be seen in the following table of refractive powers, collected from various authors, and determined by methods possessing various degrees of accuracy.

Table of the Refractive Powers of Gases, Fluids, Solids, and Metallic Bodies.

	Index of Refraction.	
A vacuum	1·0000	
GASES.[1]		
Hydrogen	1·000138	
Oxygen	1·000272	
Atmospheric air	1·000294	
Azote	1·000300	
Nitrous gas	1·000303	
Carbonic oxide	1·000340	
Ammonia	1·000385	
Carburetted hydrogen	1·000443	
Carbonic acid	1·000449	
Muriatic acid	1·000449	
Hydrocyanic acid	1·000451	
Nitrous oxide	1 000503	
Sulphuretted hydrogen	1·000644	
Sulphurous acid	1·000665	
Olefiant gas	1 000678	
Chlorine	1·000779	
Protophosphuretted hydrogen	1·000789	
Cyanogen	1 000834	
Muriatic ether	1·001095	
Phosgene	1·001159	
Vapour of sulphuret of carbon	1·001500	
Vapour of sulphuric ether, (boiling point at 35° centig.)	1·001530	

All the preceding observations were made by M. Dulong, excepting that on atmospheric air, which we owe to M. Biot.

	Index of Refraction.	
FLUIDS AND SOFT SOLIDS.		
Ether expanded by heat to thrice its volume	1·0570	Br.
Volatile new fluid discovered by Sir D. Brewster in cavities in topaz	1·1311	Br.
Volatile new fluid discovered by Sir D. Brewster in amethyst, at 83½° Fahr.	1·2106	Br.
Second new fluid discovered by Sir D Brewster in topaz	1.2047	Br.
Nitrous oxide, liquified by pressure	much less than water	F.
Muriatic acid gas, do. / Carbonic acid gas, do. — nearly equal	much less than water	F.
Chlorine, liquified by pressure	rather less than water	F.
Cyanogen, liquified by pressure	perhaps less than water	F.
Do. do. do.	1·316	Br.
Sulphurous acid, liquified by pressure	same as water	F.
Water	1·336	N. W. Br.
—— fixed line E[2]	1·33585	Fr.
Aqueous humour of the eye	1·3366	Br.
—— of haddock	1·341	Br. Y.
Vitreous humour of eye	1·336	W.
	1·3394	Br.
	1·340	Br. Y.
—— lamb	1·345	Br. Y.
—— pigeon	1 353	Br. Y.
Saliva	1·339	Br. Y.
Expectorated mucus	1·339	Br. Y.
Salt water	1·343	Br.
Vinegar, distilled	1·344	Eul.
	1·372	H.
	1·347	Br. Y.
Acetic acid	1·396	Br.
Jelly fish (medusa æquorea)	1·345	Br.
White of an egg	1·351	Eul.
—— a hen's do	1·359	Br. Y.
	1·361	Br.
Port wine	1·351	Br. Y.
Human blood	1·354	Br. Y.
Saturated solution of alum and water	1·356	He.
Oil of boxwood	1·356	Br. Y.
Ether	1·358	W.
	1·374	Br. Y.
Albumen	1·36	W.
Brandy	1·360	Br Y.
Rum	1·360	Br. Y.
Oil of ambergris	1·368	Br.
	1·379	Br. Y.
Alcohol	1·37	W.
—— sp. gr. 0 866	1·37	N.
	1·371	C.
—— rectified spirits	1·372	He.
	1·374	Br.
	1·377	Br. Y.
Saturated solution of salt	1·375	C.
Muriatic acid	1·376	Br
—— sp. gr. 1·134	1·392	He.
	1·391	Br. Y.
—— strong	1·401	Br.
—— highly concentrated	1·4098	Bi.
Oil of wine	1·379	Br.
Sweet spirit of nitre	1·384	He.
Cornea of a lamb	1·386	
Malic acid	1·395	Br.
Pus	1·404	Br. Y.
Nitrous acid	1·396	Br.
	1·404	Br. Y.
Nitric acid	1·406	Br.
Crystalline lens of man, outer coat	1·3767	Br.
—— middle coat	1·3786	Br.
—— centre	1·3970	Br.
—— lamb's eye, outer coat	1·386	Br. Y.
—— middle coat	1·428	Br. Y.
—— centre	1·436	Br. Y.
—— pigeon	1·406	Br. Y.
—— haddock's eye, outer coat	1·410	Br. Y.
—— centre	1·439	Br. Y.
—— of the ox	1·380	W.
	1·447	W.
	1·463	Eu.
Juice of orange peel	1·403	Br. Y.
Solution of potash, sp. gr. 1·416; fixed line E	1·40563	Fr.
Nitric acid, sp. gr. 1·48	1·410	Br. Y.
	1·410	W.
	1·412	C.
Hydrate of soda, melted by heat	1·411	Br. Y.
Hydrophosphoric acid, do.	1·423	Br. Y.
Phosphoric acid fluid	1·426	Br.
Yolk of a fresh egg	1·428	Br. Y.
Sulphuric acid, sp. gr. 1·7	1·429	N.
	1 430	He.
	1·435	W.
	1·440	Br.
Oil of rhue	1·433	Br.
	1·449	Br. Y.
Phosphorous acid	1·437	Br. Y.
Hydrophosphoric acid, cold	1·441	Br. Y.
	1·442	Br.
Spermaceti, melted	1·446	W.
	1·444	Br. Y.
Oil of wax	1·452	C.
Oil of wormwood	1·453	Br.
—— boiling	1·4416	M.
Bees' wax, melted	1·453	Br. Y.
—— melting	1·4503	M.
—— boiling	1·542	W.
Oil of camomile	1·457	Br.
	1·476	Br. Y.
Oil of lavender	1·457	Br.
	1·467	W.
	1·475	Br. Y.
Tallow, melted	1·460	W.
White wax, melted	1·462	Br. Y.
Oil of poppy	1·467	Br.
	1·483	Br. Y.
Oil of peppermint	1·468	W.
	1·473	Br. Y.
Oil of rosemary	1·469	Br.
	1·472	Br. Y.
Oil of spermaceti	1·470	Br.
	1·473	Br. Y.
Oil of almonds	1·469	W.
	1·470	W.
	1·481	Br.
	1·483	Br. Y.
Oil of turpentine, rectified	1·470	W.
Spirit of turpentine, sp. gr. 0·876	1·471	N.
Oil of turpentine	1·475	Br.
	1 476	Br. Y.
	1·482	C.
—— common	1·476	W.
	1·486	He.
—— sp. gr. 0·885, fixed line E	1·47835	Fr.
Oil of olives, sp. gr. 0·913	1·467	N.
	1·469	W.
	1·470	Br.
	1·4705	He.
	1·476	Br. Y.
Oil of bergamot	1·471	Br.
	1·473	Br. Y.
Oil of birch, distilled from spermaceti	1·470	Br. Y.
	1·471	Br.

[1] Taken when the temperature was 32° Fahr., and the barometer at 29·922.

[2] The fixed line E is given in this Table for several substances, as it is in the green space, and nearly the mean ray.

Substance	Index of Refraction.	
Oil of beech ?	1·471	Br.
Oil of juniper	1·473	Br.
Butter, cold	1·474	Br. Y.
Palm oil	1·480	W.
Oil of rape seed	1·475	Br. Y.
	1·475	Br.
Naphtha	1·475	Br. Y.
Essence of lemon	1·476	W.
Oil of dill seed	1·477	Br.
	1·487	Br. Y.
Oil of thyme	1·477	Br.
	1·486	Br. Y.
Oil of cajeput	1·478	Br. Y.
Naples soap	1·483	Br.
Oil of mace, melted	1·479	Br. Y.
Oil of spearmint	1·481	Br. Y.
	1·481	Br.
Oil of lemon	1·490	Br. Y.
	1·481	Br.
Oil of pennyroyal	1·489	Br. Y.
	1·482	Br.
Linseed oil, sp. gr. 0·932.	1·485	Br. Y.
	1·482	N.
	1·485	W.
Oil of savine	1·487	Br. Y.
Oil of juniper	1·482	Br.
	1·482	
Train oil	1·491	
Oil of wormwood	1·483	
	1·485	Br. Y.
Castor oil	1·489	
	1·485	
Florence oil	1·490	Br.
Oil of fenugreck	1·487	Br.
	1·488	Br. Y.
Oil of hyssop	1·487	Br.
	1·495	Br. Y.
Windsor soap	1·487	Br. Y.
Nut oil, perhaps impure	1·490	He.
	1·491	Br. Y.
	1·507	Br.
Tallow, cold	1·49	W.
	1·492	Br. Y.
Oil of caraway seeds	1·483	Br. Y.
	1·491	Br.
Oil of marjoram	1·490	Br. Y.
	1·491	Br.
Oil of nutmeg	1·491	Br. Y.
	1·497	W.
Oil of angelica	1·491	Br. Y.
	1·493	Br.
Bees' wax	1·507	Br. Y.
—— cold	1·492	
—— white wax, cold	1·535	W.
Balsam of sulphur	1·494	Br. Y.
	1·497	Br.
Honey	1·495	Br. Y.
Grass oil	1·496	Br.
Treacle	1·500	W.
Oil of beech nut	1·500	
Oil of rhodium	1·500	Br.
	1·505	
	1·503	Br. Y.
Spermaceti, cold	1·503	
	1·535	W.
Oil of pimento	1·503	Br. Y.
	1·510	
	1·507	Br.
Oil of amber	1·505	W.
	1·507	Br. Y.
Bird lime	1·506	
Oil of sweet fennel seeds	1·506	Br.
	1·507	Br. Y.
Balsam of capivi	1·507	W.
	1·515	Br. Y.
Canada balsam	1·528	W.
	1·532	Br. Y.
	1·549	Br.

Substance	Index of Refraction.	
Oil of cinnamon	1·508	Br.
Oil of mace	1·519	Br. Y.
	1·522	
Oil of sassafras	1·532	Br.
	1·536	W.
	1·544	Eu.
Balsam of Gilead	1·529	Br. Y.
Oil of cloves	1·514	Eu.
	1·535	W.
	1·539	Br. Y.
Oil of cashew nut	1·536	Br. Y.
Oil of anise seed	1·519	Eu.
	1·536	Br. Y.
	1·601	Br.
Petroleum	1·544	Br. Y.
Oil of tobacco	1·547	Br.
Balsam of styrax	1·584	
Oil of cinnamon	1·534	Eu.
	1·589	
	1·604	Br. Y.
	1·632	
Balsam of Peru, mean	1·600	Br.
Essential oil of bitter almonds	1·603	
Oil of cassia	1·626	Br. Y
	1·631	
	1·641	
	1·647	Br.
Sulphuret of carbon	1·678	
Muriate of antimony, variable, about	1·8	W.
SOLIDS.		
Tabasheer from Vellore	1·1111	Br.
—— Nagpore	1·1454	Br.
—— ditto	1·1503	Br.
—— whitest kind	1·1825	Br.
Ice	1·3085	Br.
	1·310	W.
Cryolite	1·344	Br.
	1·349	
Carbonate of potash, lowest refr.	1·379	Br.
Gluten of wheat, dried	1·426	Br. Y.
Fluor spar	1·433	W.
	1·436	Br.
Alum	1·457	W.
—— sp. gr. 1·714	1·458	W.
	1·488	Br. Y.
Sulphate of magnesia	1.465	Br.
	1·488	
Borax, sp. gr. 1·7149	1·467	N. C.
	1·475	Br.
Fluellite	1·47	W.
Gum Arabic, sp. gr. 1·375	1·467	N.
Gmelinite	1·474	Br.
Opal, partly hydrophanous	1·479	
Arseniate of soda, least	1·479	Ha.
—— greatest	1·481	
Sulphate of ammonia and magnesia	1·483	
Camphor	1·487	W.
	1·496	Br. Y.
—— sp. gr. 1·0996	1·500	C. N.
Obsidian	1·488	Br.
Iceland spar, ext	1·488	W.
—— ditto	1·4833	M.
—— fixed line E, do.	1·4887	Ru.
—— ord	1·657	W.
—— ord	1·6543	M.
—— fixed line E, ord	1·6636	Ru.
—— ord	1·667	N.
—— ord	1·665	Br.
Sulphate of iron, greatest	1·494	Br.
Sulphate of potash	1·475	W.
	1·509	Br.
Rochelle salt, mean, green	1·4985	He.
—— red	1·4929	He.
—— tartrate of potash and soda	1·515	Br.

Substance	Index of Refraction.	
Yolk of an egg, dry	1·500	Br. Y.
Triple oxalate of chromium and potash, least	1·506	Br.
—— greatest	1·605	
Glass plate, English	1·500	W.
—— French	1·50	
—— English, ext. red ray	1·5133	He.
	1·514	Bosc.
—— Dutch	1·517	W.
—— crown	1·525	
—— crown, prism Dollond, ext. red ray	1·526	He.
—— crown, prism Dollond,	1·5109	Br.
—— crown, Fraunhofer, No. 13, sp. gr. 2·535, fixed line E,	1·5314	Fr.
—— do., No. 9, fixed line, sp. gr. 2·535	1·5330	Fr.
—— Fraunhofer, sp. gr. 2·756, fixed line E,	1·5631	Fr.
—— bottle	1·582	Br.
Starch, dry	1·504	Br. Y.
Stilbite	1·508	Br.
Gum scammony	1·510	Br. Y.
Gum Arabic	1·512	Br.
—— not quite dry	1·513	Br. Y.
	1·514	W.
Human cuticle	1·514	W.
	1·517	
Nitre, least index	1·335	Br.
—— greatest	1·514	Br.
—— sp. gr. 1·9	1·524	N.
Dantzic vitriol, sulphate iron	1.515	N.
Nadelstein from Faroe	1·5153	Br.
Mesotype, least	1·516	
—— greatest	1·522	Br.
Sulphate of zinc, ordin. refr.	1·517	
Myrrh gum	1·517	Br. Y.
	1·526	
Tartaric acid, least	1·518	Br.
—— greatest	1·575	
Wavellite	1·52	W.
Gum dragon, (tragacanth),	1·520	Br.
	1·66	W.[1]
Glass—borax, 1; silex, 2	1·528	Br.
Gum or shell lac	1·521	W.
	1·525	Br. Y.
	1·528	
Caoutchouc	1·524	W.
	1·534	Br.
	1·557	Br. Y.
Selenite, sulphate of lime	1·525	W.
—— greatest refraction	1·536	Br.
A selenites, sp. gr. 2·252	1·488	N.
Citric acid	1·527	Br.
Leucite	1·527	Br.
Crystalline of ox and fish, dried	1·530	W.
Pitch	1·531	W.
	1·581	Br. Y.
	1·586	Br.
	1·58	Br. Y.
Sulphate of copper, least refraction	1·531	
	1·552	
Olibanum gum	1·532	Br. Y.
	1·544	Br.
Glass of phosphorus, phosphoric acid fused	1·532	
Solid phosphoric acid	1·544	Br.
Glass of borax, fused borax	1 532	
Manna	1·533	Br. Y.
Arragonite, ext. index	1·5348	M.
—— ord	1·6931	M.
—— 1st axis of elasticity	1·5326	Ru.
—— 2d ditto	1·6863	Ru.
—— 3d ditto	1·6908	Ru.
Arseniate of potash	1·535	W.

[1] Dr. Wollaston informed us that he had mistaken Dragon's Blood for Gum Dragon.

	Index of Refraction	
Fahlunite	1·535	Br.
Elemi gum	1·535	W.
	1·547	Br. Y.
	1·550	Br. Y.
Mastic gum	1·535	W.
	1·549	Br. Y.
	1·568	Br.
Anime gum	1·535	W.
	1·546	Br. Y.
Copal gum	1·535	W.
	1·549	Br.
	1·553	Br. Y.
Sugar, white	1·536	W.
	1·541	Br. Y.
—— melted	1·548	Br. Y.
Felspar	1·536	Br.
Mellite, least	1·538	Br.
—— greatest	1·556	Br.
Juniper gum	1·538	Br.
	1·541	Br. Y.
Carbonate of barytes, least	1·540	Br.
Boxwood	1·542	W.
Colophony	1·543	W.
Apophyllite,	1·5431	He.
Carbonate of strontian, least	1·543	Br.
—— greatest	1·700	Br.
Dichroite, Iolite	1·544	Br.
Rock salt, sp. gr. 2·143	1·545	N.
	1·557	Br.
Chio turpentine, mean	1·551	Br.
Sagapenum gum	1·545	Br. Y.
Turpentine	1·545	Br. Y.
Burgundy pitch, mean	1·558	Br. Y.
Gum thus, mean	1·550	Br.
Rock crystal, ord	1·547	W.
—— ext	1·562	Br.
—— ditto	1·563	W.
Amethyst	1·562	W.
Quartz, ord. ray	1·5484	M.
—— ext	1·5582	M.
—— ord., line E	1·5471	R.
—— ext. ditto	1·5563	R.
Amber	1·547	W.
—— sp. gr. 1·04	1·556	N.
Resin, mean	1·554	Br.
Glue, nearly hard	1·553	Br. Y.
Chalcedony	1·553	Br.
Comptonite	1·553	Br.
Opium	1·559	Br. Y.
	1·57	W.
Hyposulphate of lime, mean red ray	1·561	He.
—— mean green	1·566	He.
Dragon's blood	1·562	Br. Y.
Horn	1·565	Br.
	1·58	W.
Wernerite, ext	1·563	Br.
—— ord	1·594	Br.
Baryto-calcite, least	1·565	Br.
—— greatest	1·701	Br.
Glass, pink coloured	1·570	Br.
Assafœtida	1·575	Br. Y.
Flint glass, var. specimens	1·576	Br.
	1·578	He.
	1·583	W.
—— extreme red	1·584	He.
	1·594	Bosc.
	1·596	Br.
	1·601	He.
	1·604	Br. Bosc.
—— Fraunhofer, No. 3, line E	1·6145	Fr.
—— No. 30, line E,	1·6374	Fr.
—— No. 23, ditto	1·6405	Fr.
—— No. 13, ditto	1·6420	Fr.

	Index of Refraction	
Prussiate of potash	1·586	Br.
Anhydrite, ord	1·5772	Bi.
—— ext	1·6219	Bi.
Gum ammoniac	1·585	He.
Hyposulphite of lime, least	1·583	He.
—— greatest	1·628	He.
Emerald	1·585	Br.
Benzoic gum, mean	1·591	W.
Tortoise shell	1·591	Br.
Guiacum gum	1·596	W.
	1·600	Br. Y.
	1·619	Br.
Beryl	1·598	Br.
Balsam of Tolu	1·60	W.
—— mean	1·618	Br.
Siliceo-carbonate of zinc and iron, least	1·6005	Br.
—— greatest	1·8477	Br.
Hopeite, ord	1·601	Br.
Glass, ruby red	1·601	Br.
Meionite	1·606	Br.
Iron sinter	1·606	Br.
Glass, purple coloured	1·608	Br.
Resin of jalap	1·608	Br. Y.
Hyposulphite of strontian, least	1·608	He.
—— greatest	1·651	He.
Topaz, colourless	1·6102	Bi.
—— 1st axis of elasticity	1·6145	Ru.
—— 2d ditto ditto	1·6167	Ru.
—— 3d ditto ditto	1·6241	Ru.
—— bluish, from Cairngorm	1·624	Br.
—— Brazil, ord	1·6323	Bi.
—— ext	1·6401	Bi.
—— blue Aberdeen	1·636	Br.
—— yellow	1·638	Br.
—— red	1·652	Br.
Siliceo-carbonate of zinc from Aachen, least	1·6173	Br.
—— greatest	1·6395	Br.
—— from Bohemia, least	1·600	
—— greatest	1·848	
Glass, bright green,	1·615	Br.
Castor,	1·623	Br.
Sulphate of barytes, ord	1·6352	M.
—— ext	1·6468	M.
—— ord	1·6201	Bi.
—— ord. yellow, green rays	1·6460	He.
—— another specimen, red rays	1·6459	He.
—— ditto, yellow, green rays	1·6491	
—— a pseudo-topazus, sp. gr. 4·27	1·643	N.
—— do. do	1·646	W.
Muriate of ammonia	1·625	Br.
Aloes	1·634	Br. Y.
Glass, opal coloured	1·635	Br.
Euclase, ord	1·6429	Bi.
—— ext	1·6630	Bi.
Sulphate of strontian	1·649	Br.
Glass, hyacinth red	1·647	Br.
Mother-of-pearl	1·653	Br.
Spargelstein	1·657	Br.
Epidote, least	1·661	Br.
—— greatest	1·703	Br.
Tourmaline	1·668	Br.
Chrysolite, least	1·660	Br.
—— greatest	1·685	Br.
Chloruret of sulphur	1·67	He.
Nitrate of bismuth, least	1·67	He.
—— greatest	1·89	He.
Glass, orange coloured	1·695	Br.
Boracite	1·701	Br.

	Index of Refraction	
Glass, tinged red with gold	1·715	Br.
—— deep red	1·729	Br.
Euchroite, least	1·709	Br.
Nitrate of silver, least	1·729	Br.
—— greatest	1·788	Br.
Hyposulphite of soda and silver, least	1·735	He.
—— greatest	1·785	He.
Axinite	1·735	Br.
Nitrate of lead	1·758	Br.
Cinnamon stone	1·759	Br.
Chrysoberyl	1·760	Br.
Spinelle	1·756	He.
	1·761	Br.
	1·812	W.
Felspar, greatest refr	1·764	Br.
Sapphire, white	1·768	W.
—— blue	1·794	Br.
Rubellite	1·768	He.
	1·779	Br.
Ruby	1·779	Br.
Zircon, orange coloured	1·782	Br.
Glass lead, (flint)	1·787	Ze.
Pyrope	1·792	Br.
Labrador hornblende	1·80	He.
Arsenic	1·84	W.
Carbonate of lead, least	1·813	Br.
—— greatest	1·084	Br.
Garnet	1·815	Br.
Borate of lead, fused, extreme red ray	1·866	He.
Sulphate of lead	1·925	Br.
Withamite, least	1·931	Br.
—— greatest	1·960	Br.
Glass, lead 2—sand 1	1·987	W.
Zircon	1·95	W.
—— least refraction	1·961	Br.
—— greatest ditto	2·015	Br.
Sulphur, native	1·958	Hauy.
	2·008	Br. Y.
	2·04	W.
	2·115	Br.
—— melted	2·148	Br.
Calomel	1·970	Br.
Tungstate of lime, least	1·970	Br.
—— greatest	2·129	Br.
Glass, lead 3—flint 1	2·028	Ze.
Scaly oxide of iron	2·1	Y.
Glass of antimony	1·889	N.
	1·980	W.
	2·15	Po.[1]
	2·216	Br.
Silicate of lead, atom to atom, extreme red	2·123	He.
Phosphorus,	2·125	Br. Y.
	2·224	Br.
Blende	2·260	Br.
Nitrite of lead, biaxal, in six-sided prisms, ord. ray	2·322	He.
Diamond, sp. gr. 3·4	2·439	N.
	2·470	Br.
—— brown coloured	2·487	Br.
	2·775	Rodw.
Plumbago, from	2·04	W.
to	2·44	W.
Chromate of lead	2·479	Br.
—— another kind, least refraction	2·503	Br.
—— another kind, do.	2·508	Br.
—— another kind, greatest refraction	2·974	Br.
—— another kind, do.	2·926	Br.
Octohedrite	2·500	Br.
Realgar, artificial	2·549	Br.
Red silver ore	2·564	Br.

In the preceding Table, the letter *N* affixed to any index of refraction, indicates that the observation was made by Newton; *H*, Hauksbee; *E*, Euler; *M*, Malus; *C*, Cavallo's table; *Ru*, Rudberg; *Bi*, Biot; *Po*, Potter; *Ze*, Zeiher; *Bosc*, Boscovich; *Fr*, Fraunhofer; *He*, Sir John Herschel; *F*, Mr. Faraday; *Hai*, Haidinger; *W*, Wollaston; *Br*, Sir David Brewster; and *Br. Y*, by Dr. Young, who calculated the indices from Sir David Brewster's observations.

[1] Deduced from its polarising angle, which was 65°.

If light is regarded as consisting of material particles, it must move with greater velocity in bodies than in vacuo, in the proportion of the sines to which the refraction of these bodies is proportional. The power of bodies, therefore, to refract and reflect light, must be inversely proportional to their specific gravities; for if a body of small specific gravity has the same index of refraction as a body of great specific gravity, the former must have exercised a greater absolute force upon light than the latter.

On the hypothesis of emission, it has been shewn by Sir Isaac Newton, that the absolute refractive power of bodies is proportional directly to the square of the cosine of their maximum angle of refraction, and inversely to their specific gravity; that is, calling R the absolute refractive power, m the index of refraction, and D the density of the body, we shall have $R=\frac{m^2-1}{D}$, a formula by which the following table of absolute refractive powers has been computed. The numbers marked *Dulong*, were, we believe, computed by Sir John Herschel, from the refractive indices given by Dulong in the preceding table.

Table of Absolute Refractive Powers.

	Index of Refraction.	
Tabasheer	0·0976	
Cryolite	0·2742	Brewster.
Fluor spar	0·3426	
Oxygen	0·3799	Dulong.
Sulphate of barytes	0·3829	Dulong.
	0·3979	Newton.
Sulphurous acid gas	0·4455	
Nitrous gas	0·4491	Dulong.
Air	0·4528	
	0·4530	Biot.
	0·5208	Newton.
Carbonic acid gas	0·4537	
Azote	0·4734	Dulong.
Chlorine	0·4813	
Glass of antimony	0·4864	Newton.
Nitrous oxide	0·5078	Dulong.
Phosgen	0 5188	
Selenite	0·5386	Newton.
Carbonic oxide	0·5387	Dulong.
Quartz	0·5415	Malus.
Rock crystal	0·5450	Newton.
Common glass	0·5436	
Muriatic acid gas	0·5514	Dulong.
Sulphuric acid	0·6124	Newton.

	Index of Refraction.	
Calcareous spar	0·6424	Malus.
	0·6536	Newton.
Nitre	0 6440	Brewster.
	0 7079	Newton.
Muriate of soda	0·6477	
	0·7100	Brewster.
Alum	0·6570	Newton.
Nitric acid	0·6676	Brewster.
Borax	0·6716	Newton.
Hydrocyanic acid	0·7366	Dulong.
Ruby	0·7389	Brewster.
Sulphate of iron	0·7551	Newton.
Muriatic ether vapour	0 7552	Dulong.
Brazilian topaz	0·7586	Brewster.
Rain water	0·7845	Newton.
Flint glass, mean	0·7986	Brewster.
Cyanogen	0 8021	Dulong.
Sulphuretted hydrogen	0·8419	
Gum Arabic	0·8574	Newton.
Sulphuret of carbon vapour	0·8743	
Sulphuric ether vapour	0·9138	Dulong.
Protosulphuretted hydrogen	0·9680	

	Index of Refraction.	
Ammonia	1·0032	Dulong.
Alcohol, rectified	1·0121	
Carbonate of potash	1·0227	Brewster.
Chromate of lead	1·0436	
Olefiant gas	1·0654	Dulong.
Muriate of ammonia	1·0788	Brewster.
Carburetted hydrogen	1·2204	Dulong.
Camphor	1·2551	
Oil of olives	1·2607	Newton.
Oil of linseed	1·2819	
Spirit of turpentine	1·3222	
Bees' wax	1·3308	Malus.
Amber	1 3654	Newton.
Octohedrite	1·3816	Brewster.
Bi-sulphuret of carbon	1·4294	
Diamond	1 4566	Newton.
Oil of cinnamon	1·4944	
Oil of cassia[1]	1·6184	
Realgar	1·6666	Brewster.
Ambergris	1·7000	
Sulphur	2·2000	
Phosphorus	2 8857	
Hydrogen	3·0953	Dulong.

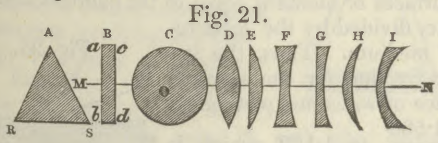
The results given in the preceding tables are susceptible of increased accuracy, not only by taking accurate measures of the indices of refraction of the bodies, in relation to the fixed line E of the spectrum, but also by obtaining more accurate measures of their specific gravities.

SECT. II.—*On the Refraction of Rays by bodies with plane and spherical surfaces.*

Having shewn how to find the refracted ray, when the incident ray is given, and the constant ratio of refraction which belongs to any transparent body, we may trace the progress of rays through bodies of any form whatever, provided we have the lines given which are perpendicular to the surface of the body at the points where the rays fall upon it. In all spherical surfaces this perpendicular is a line drawn through the point of incidence and the centre of the spherical surface; and in all other cases it is a line perpendicular to a line touching the surface at the point of incidence.

The names of *prisms* and *lenses* have been given to those transparent bodies which are most useful in optical experiments, and in the construction of optical instruments. Sections of these different refracting bodies are shewn in the annexed diagram.

Fig. 21.



1. A *prism*, represented in the figure at A, is a solid piece of glass, having three plane surfaces, AR, AS, RS, which are called its refracting faces, the light passing through any two of them.

2. A *plane lens*, B, is a lens, the centre of whose surfaces are infinitely distant. Its sides are therefore parallel like a piece of plane glass.

3. A *spherical lens*, C, is a lens whose surfaces have the same centre, and is consequently a sphere or a part of one.

4. A *double convex lens*, D, has two convex spherical surfaces, whose centres are on opposite sides of the lens. It is said to be *equally convex* when the radii of its two surfaces are equal; and *unequally convex* when the radii are unequal.

5. A *plano-convex lens*, E, is a lens which has one of its surfaces flat or *plane*, and the other *convex*.

6. A *double concave lens*, shewn at F, is a solid bounded by two concave spherical surfaces. It is *equally concave* when its surfaces have the same radius, and *unequally concave* when they have different radii.

7. A *plano-concave lens*, G, has one of its surfaces concave and the other plane.

8. A *meniscus lens*, H, has one of its surfaces *concave* and the other *convex*, the two surfaces meeting if continued. The convexity predominates, and it acts as a convex lens.

9. A *concavo-convex lens*, I, differs from the meniscus only in the circumstance that the two surfaces do not meet if continued. Hence the concavity predominates, and the lens acts as a concave one.

[1] Assuming the specific gravity to be 1·044, the same as oil of cinnamon.

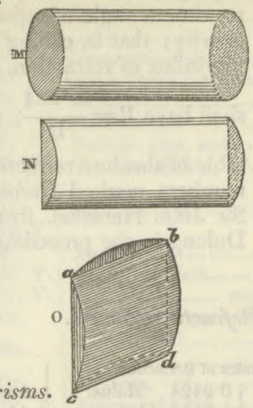
Dioptrics.

10. A *cylindrical lens* is shewn at M; it is merely a cylinder of glass, or any other transparent body.

11. A *plano-cylindrical lens*, shewn at N, has one of its surfaces plane and the other cylindrical.

12. A *transverse cylindrical lens*, shewn at O, resembles two plano-cylindrical lenses, plane transversely, or with their lengths at right angles to each other, and joined together by their plane surfaces at *a b c d*.

Fig. 22.

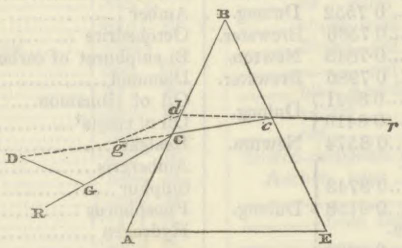


Refraction through Prisms.

As prisms are essential parts of optical instruments, and are of peculiar value in experiments on light, it is necessary to have a correct idea of the phenomena which they exhibit, in refracting rays of light.

Let ABE be a prism of two equal sides BA, BE, and made of glass whose index of refraction is 1·500, or whose ratio of refraction is as 1·500 to 1, or as 3 to 2, and let RC be a ray incident on its first surface at C. It is required to determine the path of this ray after it has suffered refraction at both its surfaces AB, BE. From any scale set off CG equal to 10 divisions, and CR equal to 15, and through G draw GD perpendicular to AC. From the point C, and on the line CD, set off CD equal to CR, and through D and C draw D C*c*,—C*c* will be the refracted ray. From a scale on which C*c* is 10, set off *c*G equal to 15 parts, and drawing *gd* perpendicular to BE, make *cd* equal to *c*C, and draw through *d* and *c* the line *dcr*,—*cr* will be the path of the ray refracted by the second surface BE of the prism. When the radius C*c* will not reach the perpendicular *gd*, the ray C*c* will not be refracted at all, but will suffer total reflexion. When total reflexion commences, the point *d* will fall in the line EB, and the perpendicular *gd* will touch the circle described with the radius *c*C round *c*, at the point *d*. At all greater angles of incidence the ray C*c* will be totally reflected.

Fig. 23.



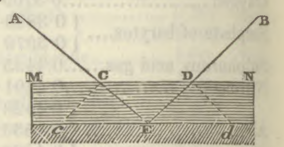
The sine of the angle of incidence at *c*, when the ray C*c* is not able to emerge from the prism, but suffers total reflexion, will be found in the case of plate glass (whose index of refraction is 1·500), to be equal to $\frac{1}{1{\cdot}500}$, or $\frac{2}{3}$, or 0·666; the angle corresponding to which is 41° 48′.

The total reflexion which thus takes place within transparent bodies, is a very remarkable and highly interesting phenomenon. The light is far more brilliant than what is obtained from the brightest silver, which gives more reflected light than any other metal; and it possesses curious physical properties, which will be explained in a subsequent part of the article. The phenomenon of total reflexion may be finely seen by filling a tumbler-glass with water, and placing it above the head so as to see the image of a candle reflected from the lower side of its surface when at rest. The brilliancy of the image surpasses that of every other species of reflexion. Diamonds, precious stones, and the glass ornaments of chandeliers, &c. &c., are often cut so as to send to the eye light that has suffered total reflexion. The brilliant white lustre of dew-drops arises from totally reflected light.

Dioptrics.

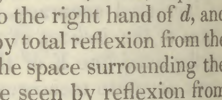
To a person under perfectly still water, the vision of objects either out of the water or on the bottom, must be very singular. The whole visible heavens, in place of being a hemisphere, will appear like a cone, with an angle of 97°. "All objects," says Sir John Herschel, "down to the horizon, will be visible in this space, and those near the horizon much distorted and contracted in dimensions, especially in height. Beyond the limits of this circle will be seen the bottom of the water and all subaqueous objects, reflected, and as vividly depicted, as by direct vision. In addition to these peculiarities, the circular space above mentioned will appear surrounded with a perpetual rainbow of faint but delicate colours." In order to understand this, let MN be the surface of the water, and E an eye at the bottom. Let DE be the direction in which a horizontal ray ND, would be refracted at D, and CE the direction in which MC would be refracted at C. Then it is clear that all objects on the horizon will be seen in the directions ED, EC, and as the same is true in every azimuth, ACEDB will be a section of the cone, which will comprehend within it all objects in the visible horizon. The sun and moon will appear to rise at A and set at B. They will have the appearance of ovals, with their smaller diameters vertical. They will quit the horizon, and descend to it again very slowly, as the angle of refraction varies very slowly from 90° of incidence downwards. If a man fishing near N stands up to his knees in water, his knees will just be seen above the water, in the direction EB, and his body standing within the cone BEA, while his legs will be seen bright, and inverted in the direction of about EN, by the total reflexion of the lower surface MN, of the water. If we draw C*c* and D*d*, making the angles *c*CE, *d*DE, equal to CED, then all objects in the water, to the right hand of *d*, and to the left hand of *c*, will be seen by total reflexion from the inner surface MN of the water, in the space surrounding the cone AEB. An object at *c* will be seen by reflexion from the point C, in the direction EC, and an object at *d* by reflexion from D; but none of the objects between *c* and *d* will be seen by reflexion to the eye at E. Hence we see the reason why the fisherman's legs, like other objects under water, will be seen by total reflexion in a direction near to EN. The circular rainbow, or rather fringe of colours, which separates the objects out of the water from those which are beneath it, and seen by total reflexion, is that band of colour which always bounds light that is totally reflected.

Fig. 24.



It frequently happens, both in optical experiments and in optical instruments, that light is refracted at the surfaces of two media placed in contact, such as water and glass, and in compound lenses of flint and crown glass, either touching one another or united by a cement. In all such cases, it is necessary to determine the refraction which light experiences at their refracting surface. It is found by experiment, and may be proved theoretically, that the index of refraction for the separating surfaces of media is equal to the quotient of the most refractive, divided by the least refractive medium. Thus, the index of refraction for the separating surface of water and plate glass will be $\frac{1{\cdot}500}{1{\cdot}336}$, or 1·122, which is nearly the same as that of tabasheer. In order, therefore, to find the refracted ray in this case, let MN be

Fig. 25.



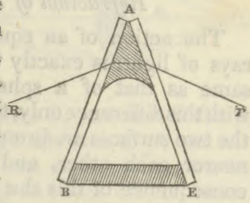
a parallel stratum of water resting upon a piece of parallel glass OP. A ray RC, will be refracted in the direction Cc', and may be found by the method formerly given. In order to find the change produced in the direction of the ray at c', take a point g', in the line c'C, so that if c'C is 1·122, $c'g'$ shall be 1·000, then drawing $g'd'$ perpendicular to the refracting surface, make $c'd'$ equal to c'C; and having drawn through the points d', c' the line $d'c'c'$,—$c'c$ will be the refracted ray. This ray being incident on the second surface of the glass plate at c, will be refracted in a direction cr, which may be found by the method formerly described. It will be found both by projection and by experiment, namely, by looking through the compound plate MNOP, and observing any distant object, that the finally refracted ray cr is parallel to the incident ray RC.

If the angle RCA, fig. 23, the complement of the angle of incidence, is increased, the point c, where the refracted ray emerges from the side BE of the prism, approaches to E, and the angle rcE diminishes, till at a particular inclination of the incident ray, the angle RCA will become equal to the angle rcE. When this happens, the refracted ray Cc, will be equally inclined to the refracting faces of the prism BA, BE, and will be parallel to the base AB. This will be obvious by considering Cc as an internal ray incident on both sides of the prism, and at equal angles to each, in which case it will suffer equal degrees of refraction, and therefore be equally inclined to the refracting faces.

If the eye is placed at r to receive the refracted ray cr, it will see the luminous body, such as a candle, from which the ray RC proceeds, in the direction rc, and the angle which this ray rc forms with RC, will be the deviation of the ray produced by the refraction of the prism. Let us now suppose the candle to be fixed, and the prism turned round, so that the angle RCA may be increased, it will be found experimentally, and may be easily proved by projection, that the deviation of the ray rc is *least* when the angle RCA is equal to rcE, or when Cc is parallel to AE, and increases when Cc deviates on either side from this mean position. Now this position may be easily ascertained by placing the eye behind the face BE, and turning the prism till the refracted image of the candle, or other object, becomes stationary. When this takes place, Cc is parallel to AE or CcA is an equilateral triangle; and it may easily be shewn, by similarity of triangles, or by projection, that *the angle of refraction at the first surface is equal to half the angle of the prism, or* $\frac{1}{2}$ ABE. Hence we obtain the following simple rule for finding the index of refraction, after having measured, with a goniometer or otherwise, the angle of incidence, or the complement of the angle RCA. Divide the sine of the angle of incidence by the sine of half the angle of the prism, and the quotient will be the index of refraction.

For the purpose of measuring indices of refraction, we do not require regular prisms of considerable size. Two small faces well ground and tolerably polished, are sufficient for this purpose. They need never be larger than the pupil of the eye, and will answer well enough if they are of the size of a pin's head. If we wish to measure the index of refraction of fluids, we have only to place a drop of the fluid at the angular point A, of two pieces of parallel glass fixed at any angle by a piece of wood or wax BE. Enough of the fluid for the purpose will be retained, by capillary attraction at the point A, and after measuring the angle BAE of the prism, and the angle of incidence at which the image of the candle becomes stationary, the index of refraction will be found as before.

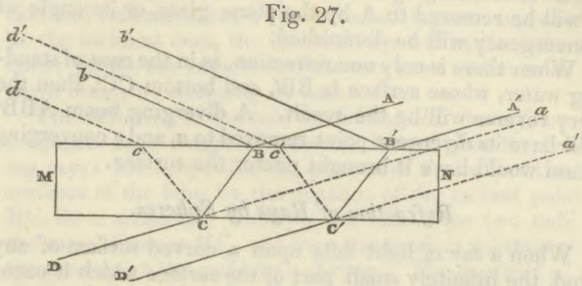
Fig. 26.



Refraction through Plane Glasses.

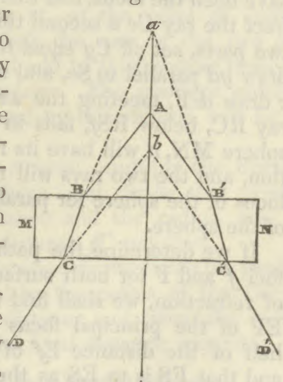
Every person is acquainted with the fact that light which passes through plane glasses, or glasses which have their two surfaces flat and parallel, like MN, in the annexed figure, does not suffer any very perceptible change, either in its general direction, or in the parallelism, convergency, or divergency of its rays. If AB, A′B′, for example, be two parallel rays incident on the plate of glass MN, they will suffer equal refractions at B, B′, because they are incident at the same angles, and the refracted rays BC, B′C′, will therefore be parallel. These parallel rays again falling upon the second surface at C, C′ will suffer equal refractions there, and will emerge parallel in the lines CD, C′D′. Hence we conclude that parallel rays after transmission, at any obliquity, through a plane glass, will emerge parallel. But as the rays DC, D′C′, will, to an eye at D and D′, be seen in the directions DCa, D′C′a', their absolute directions in space are altered, and the difference between the real and the visible direction will increase with the obliquity of the rays AB, A′B′, and with the thickness of the plate of glass. If we suppose MN to be part of a looking-glass, silvered on its lower side CC′, then the refracted rays BC, B′C′, will, after reflexion at C, C′, in the directions Cc, C′c', be refracted at c, c', into the parallel directions cd, $c'd'$. But the rays AB, A′B′, will be reflected, though in a much fainter degree, in the directions Ab, A′b', so that an eye placed so as to receive these rays, will see the bright image reflected from the silvered surface, in the direction dc, and the faint image reflected from the first surface, in the direction bB, at a distance from each other depending on the obliquity of the reflexion, and on the thickness of the plate. A candle, for example, will be seen double at a short distance from the mirror; but a larger object, in order to be seen double, must be viewed at a greater distance. At great obliquities, and when the objects are very luminous, such as gas-burners, &c., other images will be seen by reflexions at c, c', and subsequent reflexions from the other side of the plate. If the two faces of the plate are not exactly parallel, the bright and faint images above described, will change their distance, sometimes overlapping each other, and sometimes separating, according to the part of the plate on which they fall, though the angle of incidence may remain the same.[1]

Fig. 27.



When *diverging* and *converging* rays pass through a plane glass, their degree of divergency and convergency is altered by it,

Fig. 28.



[1] We had once a looking-glass of this kind sent to us as a curiosity by a gentleman, who valued it on account of its remarkable properties. It differed from all the rest in his possession, only in its being the worst.

Dioptrics.

and also the position of the points of divergency and convergency. Let ABB′ be a pencil of rays diverging from A, and incident upon the plane glass MN. The emergent rays CD, C′D′, will, after their second refraction at C, C′, proceed as if they had come from the point *b*, and their angle of divergency will now be *b*BB′. Hence a plane glass brings the divergent point of diverging rays nearer to it, and increases the angle of divergency. For the same reason, if D*b*D′ is a converging beam of light, its point of convergency *b*, will be removed to A by the plane glass, or its angle of convergency will be diminished.

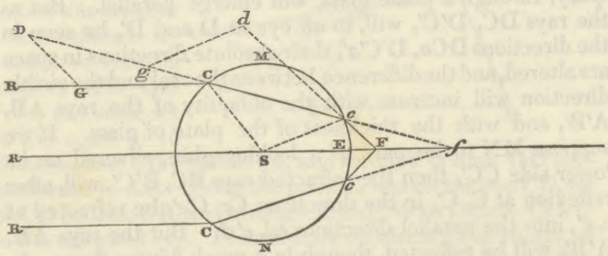
When there is only one refraction, as in the case of standing water, whose surface is BB′, and bottom CC′, then the very reverse will be the result. A diverging beam ABB′ will have its divergent point removed to *a*, and a converging beam would have it brought nearer the surface.

Refraction of Rays by Spheres.

When a ray of light falls upon a curved surface of any kind, the infinitely small part of the surface which it occupies may be considered as coinciding with the tangent to the surface, or with a plane surface touching the curve at the point of incidence. When the surface is spherical, this tangent plane is perpendicular to the radius, or the line drawn from the centre of the sphere to the point of incidence. Hence it is always given when the centre is given.

Let MN be the section of a sphere of glass, whose index of refraction is 1·500, as before, RS*f* a ray passing through

Fig. 29.



its centre S, and therefore unrefracted, because it is incident perpendicularly on both surfaces, and RC, RC, other rays parallel to, and equidistant from, RS*f*, it is required to find the path of one of these RC, through the sphere. Join SC, which will be perpendicular to the surface at C. From a scale on which RC is three parts, set off RC equal to 1, and draw CD parallel to CS, (which is the same as drawing it perpendicular to the elementary surface, or tangent to the sphere at C). Make CD equal to CR, and through D and C draw the line DC*f*, meeting the posterior surface of the sphere at *c*, and the axis of the sphere at *f*. The point *f* would have been the focus, had there been no second surface to refract the ray C*c* a second time. On a scale in which C*c* is two parts, set off C*g* equal to 1 part, and having joined S*c*, draw *gd* parallel to S*c*, and make *cd* equal to *c*C. Through *c* draw *dc*F, meeting the axis of the sphere in F. As the ray RC, below RS*f*, falls in the very same manner on the sphere MN, it will have its refracted ray in a similar direction, and the two rays will meet at F, which is called the focus of the sphere for parallel rays, or the principal focus of the sphere.

If we determine the path of the ray RC, and find the foci *f* and F for both surfaces; by using different indices of refraction, we shall find that in every case the distance EF of the principal focus of the sphere is exactly one-half of the distance E*f* of the focus for the first surface, and that FS is to ES as the sine of incidence or the index of refraction is to the difference between twice the sine of incidence and twice the sine of refraction; that is, in glass as 1·500 is to 3·000—2·000, or as 1·500 to 1·000.

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Hence we have for different refractive bodies the following results :—

	Index of refraction.	
Tabasheer,......FS is to ES as	1·111	is to 0·222
Watcr,..........FS is to ES as	1·336	is to 0·672
Glass,...........FS is to ES as	1·500	is to 1·000
Zircon,..........FS is to ES as	2·000	is to 2·000

Hence it appears that in the case of zircon, and all other bodies whose index of refraction is 2·00, the focus F falls exactly on the posterior surface of the sphere at E, and it therefore follows that in diamond, phosphorus, &c., and all bodies whose refractive power exceeds 2·000, the principal focus falls *within the sphere*, the focus advancing from E towards S, as the index of refraction increases, and reaching the centre of the sphere S, when the index of refraction becomes infinite.

It may be interesting to trace the distances E of the principal focus F from the sphere, in bodies of various refractive powers, supposing the radius of sphere to be one inch, and placed in vacuo.

	Distances E F.	Feet.	Inches.
Hydrogen,..........	3623 inches............	301	11
Oxygen,.............	1838 —	153	2
Atmospheric air,...	1701 —	141	9
Phosgen,.............	432 —	36	0
Tabasheer,..........	4	0	4
Watcr,................	0·98 —	0	1 nearly.
Glass,................	0·50 —	0	½ an inch.
Zircon,...............	0·00 —	0	0
Diamond,.........	within the sphere.		

In spheres of diamond and other substances of high refractive power, a refracted ray C*c* may fall so obliquely upon the inner surface of the sphere, that it would be totally reflected, and would therefore be carried round the surface of the sphere, without the possibility of making its exit. If the length of the refracted ray C*c* should cut off an arch which is an aliquot part of a circle, the ray would describe a regular polygon, being always reflected from the same points; but if it was not an aliquot part of a circle, the points of reflexion would vary in every revolution of the ray.

The following is the rule for finding the principal focus of a sphere, or its focus for parallel rays:—Divide the index of refraction by twice its excess above unity, and the quotient is the distance of the principal focus from the centre of the sphere.

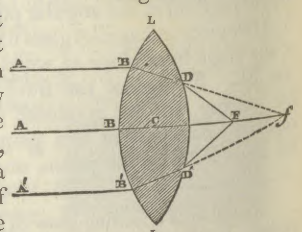
When the rays RC, RC, in place of falling on the sphere in directions parallel to the axis, or to one another, proceed from a near object, and always from a point in the axis RSE, their focus may be found by the very same method which we have already given. When the point from which the rays diverge is very distant, the focus of such rays will be a little farther from the sphere than F, and as the radiant point approaches to the sphere, the focus F will recede from it, as will be more fully explained when we treat of the progress of rays through lenses.

Refraction of Rays by Convex Lenses.

The action of an equally convex lens in refracting rays of light, is exactly the same as that of a sphere, with this difference only, that the two surfaces are brought nearer each other, and in consequence of this the ray refracted by the first surface falls upon the second surface, at a different point, and at a different angle, the effect of which is to produce a change in the position of the focus.

the Parallel rays.

Fig. 30.



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Let LL be a double and equally convex lens of glass, a line Af passing through the centre C, or middle point of its greatest thickness, is called its axis. Let *parallel rays* AB, A′B′, fall upon the first surface, at the points B, B; these will be refracted in directions BD, B′D′, which will be determined by the method shewn in fig. 28. Had there been no second surface, these rays would have converged to a focus at f, but as they meet the second surface of the lens at D and D′, they will there be refracted, as shewn in fig. 28, for the sphere, so as take the directions DF, D′F′, and have their principal focus at F.

The following is the rule for finding the principal focus of a glass lens unequally convex:—Multiply the radius of the one surface by the radius of the other, and divide twice this product by the sum of the same radii.

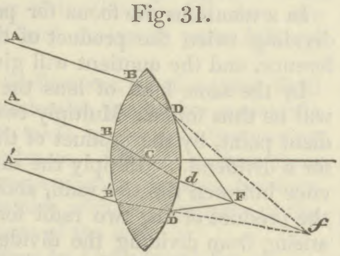
If the glass lens is equally convex, and has its index of refraction 1·500, the distance CF, or its principal focal distance, will be equal to the radius of any of its surfaces.

The following is the rule for finding the principal focal distance of a plano-convex lens of glass. When the convex side is exposed to parallel rays, the focal distance, reckoned from the plane side, will be equal to double the radius of the convex surface, diminished by two-thirds of the thickness of the lens. When the plane side of the lens is exposed to parallel rays, the distance of the focus from the convex side will be equal to twice the radius.

Oblique rays.

When the rays AB, AB are oblique to the axis, the middle ray AC passing through the centre C, will obviously suffer refraction at B, but as it falls upon the second surface at the same angle, it will be refracted a second time in an opposite direction, so that it will proceed in a direction df parallel to AB. The rays AB, AB will suffer refraction at the points B, B′, and also at the points D and D′, and it will be found by projection that they meet in a focus F in the axis $d\,f$.

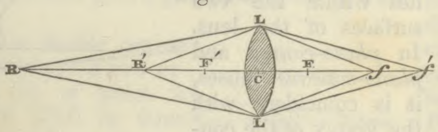
Fig. 31.



Diverging rays.

In the preceding case the parallel rays are supposed to issue from some very distant object; but if the object from which the rays proceed is near or not very distant from the lens, its focus will recede from the lens, in proportion as the object or point of divergence approaches to it. This fact scarcely requires to be proved, for it is manifest that as the radiant point approaches to the lens, the rays fall more and more obliquely on the first surface, and less and less obliquely on the second, so that the deviation produced by refraction is not sufficient to bring them to a focus so near the lens as the point F, in fig. 30. This will be better understood from fig. 32, where LL is a convex lens, whose focus for parallel rays is F. Let RL, RL be rays diverging from a candle or other body, at R, then, if we trace the refracted rays by the method already given in fig. 27, we shall find that they will meet at a point f, farther from the lens than F, and that if the point R advance to R′, the focus f will advance to f', and so on, the focus f' receding from the lens as R approaches to it. When the distance RC is equal to twice CF, or twice the principal focal distance, the distance of the focus f' from the lens will be equal to the distance of the radiant point from it, or Cf' will be equal to CR′. When R comes nearer C, f' goes rapidly away from it, and when R comes to F′, which is called the anterior focus, CF′ being equal to CF, the rays will be parallel, or what is the same thing, the focus f will have retired to an infinite distance. When R comes nearer to C than F′, the rays will diverge, after passing through the lens, as if they came from some point in front of the lens, and this point, or *virtual focus*, as it is called, will approach to the lens as R approaches it, in moving from F′ towards C. The points R and f, and R′ and f', are called *conjugate foci*, because it may be shewn that rays diverging from f will be refracted to R, and rays diverging from f' to R′. It is indeed a general truth in all the phenomena of refraction and reflexion, that if the refracted rays are supposed to be the incident ones, the incident rays will be the refracted ones; for the ray experiences the very same action in an inverse order, by retracing its path.

Fig. 32.



The following is the rule for finding the focus f, or the conjugate focal length of a convex lens of glass for diverging rays: Multiply twice the product of the radii of the two surfaces of the lens, by the distance of the radiant point or RC, for a *dividend*. Multiply the sum of the two radii by the same distance RC, and from this product subtract twice the product of the radii for a divisor. The quotient of the dividend divided by the divisor will be the focal distance Cf required.

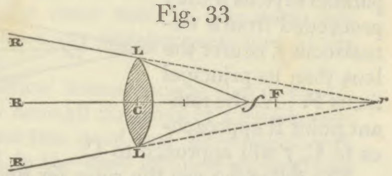
When the lens is *equally-convex*, multiply the distance of the radiant point RC, by the radius of the surfaces, and divide that product by the difference between the same distance and the radius, and the quotient will be the focal distance Cf required.

If the lens is *plano-convex*, divide twice the product of the distance of the radiant point RC, multiplied by the radius of the convex surface, by the difference between that distance and twice the radius, and the quotient will be the distance of the focus from the centre of the lens.

Converging rays.

When converging rays fall upon a convex lens, they are always refracted to a point between the lens and their point of convergence. Let RL, RL, be rays converging to any point r, behind the lens LL, it is very evident that refraction must always make them cross the axis RCr of the lens somewhere between r and the lens, and always between the principal focus F and the lens. The exact point may be found by the methods already given. As the point of convergence r recedes from the lens, the focus f will approach to the principal focus F, and when r is infinitely distant, the rays RL, RL, become parallel, and f will coincide with F. When r approaches to C, f will also approach to it.

Fig. 33



The focus of a double convex glass lens, when its thickness is small, for converging rays may be found by the following rule: Multiply twice the product of the radii of the two surfaces by the distance rC of the point of convergence for a *dividend*. Multiply the sum of the two radii by the same distance rC, and add to this product twice the product of the radii for a *divisor*. The quotient obtained by dividing the above dividend by this divisor, will be the focal distance fC required.

When the lens is *equally*-convex, multiply the distance rC by the radius of the surfaces, and divide that product by the sum of the same distance and the radius, and the quotient will give the focal distance fC required.

In *plano-convex* lenses we must divide twice the product of the distance rC multiplied by the radius of the convex surface, by the sum of that distance and twice the radius, and the quotient will give the focal distance required.

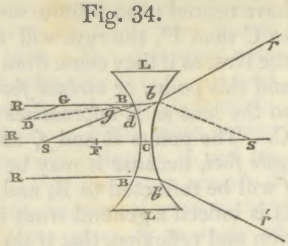
Refraction of Rays by Concave Glasses.

In order to shew how to find the refracted ray when the

Dioptrics.

light is incident on a *concave* surface, let LL be a double and equally concave lens of glass, and RB, R′B′ two rays parallel and equidistant from the axis RC of the lens. From a scale on which RB is 1·5, take BG equal to 1, and from G draw GD parallel to SB, the radius, and consequently perpendicular to the first concave surface of the lens. Make BD equal to BR, and through D and B draw B*b*, which will be the ray refracted by the first surface. On a scale where *b*B is 1, make *b*B*g* equal to 1·5. From *g* draw *gd* parallel to *bs*, the radius of the second surface, and consequently perpendicular to that surface at *b*. Make *bd* equal to *b*B, and through *b* draw *dbr*, *br* will be the ray refracted by the second surface. In like manner the other ray RB will be refracted by the first surface in the direction B′*b*′, and the two refracted rays *br*, *b′r′* will diverge as if they had proceeded from a point F, found by continuing *br*, *b′r′* backwards, which is called the virtual focus of the concave lens, LL.

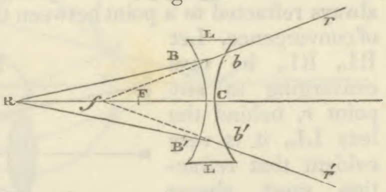
Fig. 34.



If we trace *oblique parallel* rays through a double concave lens in the same manner as we have done for a convex one in fig. 31, we shall find that they will be refracted as if they diverged from a focus in the axis or ray which passes through the centre of the lens. The rules for finding the virtual focus of paralell rays refracted by a double or plano-concave lens, are the same as for convex lenses.

When *diverging* rays RB, RB, fall upon a concave lens LL, they will be refracted in lines *br*, *b′r′*, more divergent than parallel rays, as if they proceeded from a virtual focus *f*, nearer the lens than its principal focus F. As the radiant point R approaches to C, *f* will approach to C.

Fig. 35.

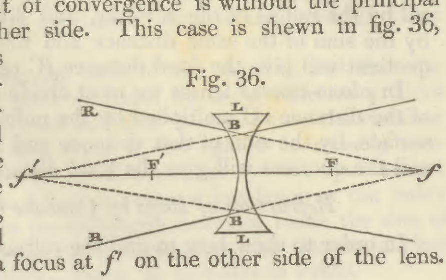


The following are the rules for finding the virtual focus of a concave lens of glass for diverging rays. Multiply twice the product of the radii by the distance RC of the radiant point R for a *dividend*. Multiply the sum of the radii by the distance RC, and add to this twice the product of the radii for a *divisor*. Divide the dividend by the divisor, and the quotient will be the virtual conjugate focal distance *f*C. If the lens is *equally-concave*, multiply the distance of the radiant point R by the radius, and divide the product by the sum and the same distance and the radius, and the quotient will be the virtual focal distance required.

If the lens is a *plano-concave* one, multiply twice the radius by the distance of the radiant point, and divide this product by the sum of the same distance and twice the radius, and the quotient will be the virtual focal distance.

When *converging rays* fall upon a concave lens, their virtual focus will be without the principal focus on one side, if the point of convergence is without the principal focus on the other side. This case is shewn in fig. 36, where the rays RB, R′B′, converging to *f*, without the principal focus F, will be refracted in the direction *br*, *b′r′*, as if they had diverged from a focus at *f′* on the other side of the lens.

Fig. 36.



When *f*C is equal to twice the principal focal distance CF, the virtual focus of divergence *f* will be at the same distance on the left hand of C as the point of convergence *f′* is distant on the right hand. When *f* approaches the lens on the right hand, the virtual focus *f* will recede from it on the left. When *f* reaches F, the virtual focus will be infinitely distant, or the refracted rays will be parallel; and when *f* advances from F to the lens, the refracted rays will converge on the right hand of the lens, and the focus will advance towards the lens, as the point of convergence advances towards it.

The rule for finding the conjugate focus of a converging beam, for a doubly concave lens, is the same as that for diverging rays in a doubly convex lens. If the lens is plano-concave, the rule is the same as for diverging rays falling upon a plano-convex lens.

Refraction of Rays through Meniscuses, and Concavo-Convex Lenses.

It would be quite unprofitable to trace the progress of different rays through these various forms of glasses, both because they are but little used, and because the very same methods which are applicable to convex and concave surfaces, are applicable also to them. When used by themselves and for ordinary purposes, these lenses are inferior to the common convex and concave lenses, and therefore are seldom met with. We shall therefore content ourselves with giving the rules for finding their foci.

In a meniscus the focus for parallel rays is obtained by dividing twice the product of the two radii by their difference, and the quotient will give the focal distance.

In the same kind of lens the focus for diverging rays will be thus found: Multiply twice the distance of the radiant point, by the product of the radii of the two surfaces, for a dividend. Multiply the same distance by the difference between the two radii, and to their product add twice the product of the two radii for a divisor. The quotient arising from dividing the dividend by the divisor, will be the focal distance of the meniscus. This rule will answer also for converging rays.

In *concavo-convex* lenses the very same rules will apply, but the rays have a virtual focus in front of the lens, as in concave lenses.

In treating of the passage of oblique rays through a double convex glass, as shewn in fig. 31, we have stated that there is a point C, called the centre of the lens, through which the ray that passes suffers the same refraction at both surfaces, or emerges parallel to its original direction. In equally double convex lenses, this centre C is accurately in the middle part of the thickness of the lens; but in other forms of lenses it is not. Hence it is necessary to point out the method of finding this centre. In *double convex* or *concave lenses*, the centre C, see fig. 31, 37, and 38, lies within the two surfaces of the lens. In *plano-convex* and *plano-concave* lenses, it is coincident with the vertex of the convex or concave surfaces, and in *meniscuses* and *concavo-convex lenses* it lies without the thickness of the lens, and nearest to the surface which has the greatest curvature. Let R, *r*, figs. 37—40, be the centres

Fig. 37.

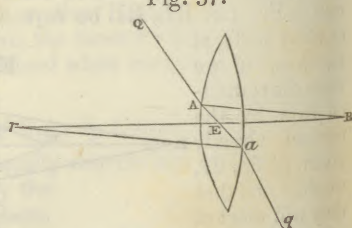
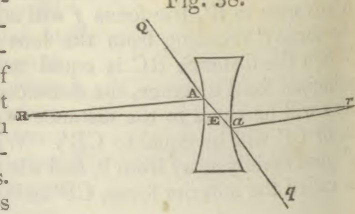


Fig. 38.



Dioptrics.

of the convex and concave surfaces of the lenses, and R*E*r, fig. 37, 38, or R*r*E, fig. 39, 40 are their axes. Taking any point A in one surface, draw RA, and parallel to this draw *ra*, which will cut the other surface of the lens in *a*. Join A*a*, and continue it till it meets the axis RER in same point E; this point E is called the centre of the lens, because every ray that passes through it will have its incident and emergent parts parallel, such as QA, and *qa*. From the similarity of the triangles REA, *r*E*a*, and the composition and division of ratios, we have $RA \mp ra : ra = RE \mp rE$ (or R*r*) : *r*E, hence *r*E must be invariable like the other lines, and on whatever point the parallel radii RA, *ra*, are drawn, the line A*a* must cut the axis R*r* in the same point E. If we suppose the ray A*a* to pass out of the lens in both directions, it will suffer the same quantity of refraction in opposite directions, because the angles of incidence *a*AR, A*ar*, are equal. Hence the incident and emergent parts AQ, *aq*, will be parallel.

Fig. 39.

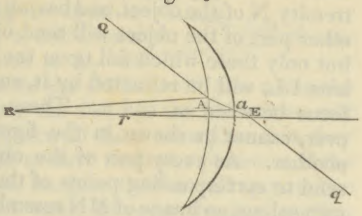
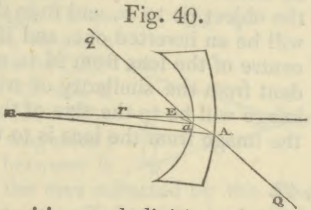


Fig. 40.



When the lens is small in diameter, or of a great focal length, or its thickness inconsiderable from other causes, the path of the ray QA*aq*, may be taken in a straight line passing through the centre E of the lenses. This is evident from the circumstance that the perpendicular distance between the lines AQ, *aq* diminishes both with the obliquity of the incident ray, and the thickness of the lens.

On the Refraction of Rays by Cylindrical Lenses.

Refraction by cylindrical lenses.

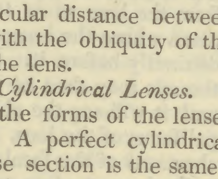
Cylindrical lenses may have all the forms of the lenses which we have already described. A perfect cylindrical lens corresponds with a sphere whose section is the same; a plano-convex cylinder has its section similar to a plano-convex lens of the same dimensions; and a meniscus cylinder has one of the cylindrical surfaces convex and another concave.

In all these cases the curved surfaces are cylindrical; that is, circular in one direction, and rectilineal in another; but we may combine a spherical surface either convex or concave, with a cylindrical surface either convex or concave, and thus produce cylindro-spherical lenses, an ingenious application of which to vision was made by Mr. Airy, for the purpose of remedying a defect in his own eye.

This class of lenses, therefore, whether entirely cylindrical, or cylindro-spherical, having been found of real use both in matters of science, and for the purposes of vision, it becomes of consequence to give a general account of their properties.

Let LLL′L′ be a double convex cylindrical lens, composed of two cylindrical surfaces, one of which is LLL′L′. Then if RRR be three parallel and horizontal rays passing through the thinnest portion of the upper part of the lens, it is obvious that they will be refracted to a focus at F, at the same distance from the lens, as in an ordinary lens. In like manner the rays R′R′R′ falling upon the lowest portion of the lens will have their focus at F′. Every intermediate portion of the lens will have a similar focus somewhere in the line FF′, and if we suppose all the rays to proceed from a distant object, such as the sun, there will be an image of the sun, or a luminous focus in every point of the line FF′, and FF′ will be a brilliant line of light.

Fig. 41.



This property of a cylindrical lens to form a bright line of light has been ingeniously applied by Captain Kater in the construction of his azimuth compass, which we have described in our article MAGNETISM, vol. xiii. p. 765.

In cylindrical lenses diverging and converging rays will have the same foci as in common and concave lenses of the same curvature; and therefore the rules for finding their foci are applicable also to them.

Cylindrical lenses have been recently applied by Sir David Brewster for improving the vision of objects that are rectilineal, such as the defective lines in the solar spectrum. When these lines are not visible, or are very imperfectly visible, on account of the imperfections of the telescope, the application of a cylindrical lens, either solid or fluid, renders them more visible when the axis of the cylinder or cylindrical surface is accurately perpendicular to the lines. A prism has a similar effect. Both of them act in filling up the irregularities of the edges of the line by a succession of images of other parts of the line. If we look, for example, at a screw nail, or a twisted or rough rope, through a prism or cylinder, whose length is perpendicular to the screw or rope, the edges of both will be as smooth as if they were polished cylinders.

A patent was taken out several years ago by a Parisian artist for a transverse cylindrical lens similar to that shewn in fig. 22 O; which differs from the cylindrical lens in fig. 41 in this, that the second cylindrical surface has the axis of the cylinder of which it is a part, perpendicular to the axis of the cylinder of which the first surface is a part. The effect of this combination is *exactly* equivalent to a plano-convex glass of the same radii of curvature, and therefore it does not possess any superior properties, as was believed by its inventor.

If we cross two cylindrical lenses, such as that in fig. 41, at right angles, we shall have all the effect of a double convex lens. Or if we cross two good test tubes filled with water or any other fluid, in the same manner, we shall also obtain a rude imitation of the effect of a spherical lens, which may answer for the common purposes of a microscope.

Mr. Airy's sphero-cylindrical spectacles.

The application of a cylindro-spherical lens by Mr. Airy to the purpose of remedying imperfect vision in his own eye deserves to be more particularly noticed. He found that his eye refracted rays to a nearer or shorter focus in a vertical than in a horizontal plane,[1] so that his eye was completely useless. Hence he concluded that the curvature of his cornea was greater in a vertical than in a horizontal plane, and he ingeniously proposed to correct this defect by cylindrical refraction. As the eye was shortsighted, he required concave surfaces to correct the general defect of a too convex cornea. He therefore had a lens constructed, which was doubly concave, one of the surfaces being spherically concave, and the other cylindrically concave, and of such a curvature as to bring to the same point the vertical and horizontal foci of the cornea. An artist of the name of Fuller, at Ipswich, constructed for Mr. Airy lenses of the proper dimensions, which enabled him to read the smallest print at a considerable distance with his defective eye, as well as he could do with the other. He found that vision was most distinct when the cylindrical surface was turned from the eye, and he placed the lens as near the eye as possible. There is another application of cylindrical lenses which we believe has not hitherto been made. In

[1] This was the case also in Dr. Thomas Young's eye, but it did not injure his vision. *El. Nat. Phil.* vol. ii. pp. 578, 9.

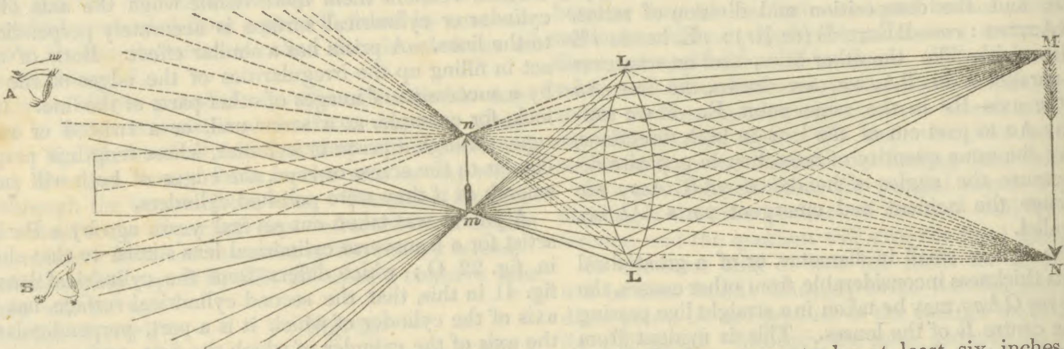
Dioptrics. all preparations of natural history, objects which are generally preserved in cylindrical bottles or vessels containing fluids, the objects are always seen distorted, being magnified to the greatest extent in a plane perpendicular to the length or axis of the cylinder, while in a rectangular direction, the object is not magnified at all. In order to see the objects of their true shape, and have them equally magnified in all directions, a cylindrical lens of a suitable focus should be employed, so that the axis of the cylinder may be at right angles to the cylindrical axis of the vessel.

Sect. III.—*On the Formation of Images by Lenses, and on the vision of objects through them.*

In the preceding section we have treated of the formation of images by rays transmitted through small apertures, and have considered the formation of images by reflecting surfaces.

In order to explain the formation of images by convex lenses, whether double, or plano-convex, or meniscuses, let LL be a convex lens, MN an object farther from it than its principal focus. Let MLL be a cone of divergent rays proceeding from M, and having their focus at *m* behind the lens; and NLL another similar cone from the other extremity N of the object, and having their focus at *n*. Every other part of the object will send out rays in all directions; but only those which fall upon the circular surface of the lens LL, will be refracted by it, and they will all have their focus between *m* and *n*. These refracted pencils, however, cannot be shewn in the figure without crossing one another. As every part of the object MN, will therefore send to corresponding points of the image *mn* rays of their own colour, an image of MN resembling it in all respects will be formed at *mn*, and as the rays from the upper part M of the object go to *m*, and from the lower part to *n*, this image will be an inverted one, and if we draw lines through the centre of the lens from M to *m*, and N to *n*, it will be evident from the similarity of triangles that the size of the image will be to the size of the object, as the distance of the image from the lens is to the distance of the object.

Fig. 42.



If we place the eye behind this image *mn*, we do not see it suspended in the air at *mn*, but it appears as if it were in front of the lens. That the image, however, is formed at *mn*, may be proved by viewing it on smoke raised at that place, or on a piece of ground glass, or semi-transparent paper; or if we bring the eye in front, we shall see it distinctly painted on any white ground, such as a piece of white paper. We shall suppose it, however, to be seen on smoke by the eye placed behind it at A or B. It will be seen exactly at *mn*, as if it were a real object; and in order to see it distinctly, the eye must view it at the same distance as it views other objects, and it may be viewed as any other object is, through a pair of spectacles or a magnifying glass.

As all the rays from M, N cross each other at the points *m*, *n* of the image, the very same rays radiate from those points that radiated from M, N, and consequently the very same effect must be produced in the eye as if these rays proceeded from a real object at *mn*. Hence by placing another convex lens at a proper distance behind *mn*, a distance greater than its principal focus, we may form another image of this image, in the conjugate focus of the second lens.

If we wish to form a magnified image of an object by any lens, we have only to place the object nearer the lens, and it follows from the rules for conjugate foci that the image will increase. If MN, for example, is brought nearer LL, the image *mn* will recede from the lens, and increase in size. When ML is equal to twice the principal focal distance of the lens, the distance of the image *m*L, and the size of the image will be the same as that of the object MN. If MN comes still nearer the lens, *mn* will recede still farther, and continue to increase in size till it becomes infinitely large and infinitely distant. When this happens, the rays which form it will have become parallel. If during all these changes the eye is withdrawn from the lens so as to be at least six inches behind the place where the image is formed, it will observe the image distinctly before it. But when the rays become parallel, the eye may then be placed immediately behind the lens, and it will see the object distinctly in the anterior principal focus of the lens, and magnified in proportion to the shortness of the focal distance of the lens.

In the preceding paragraphs, we have described the principles of the *camera obscura*, the *compound microscope*, and the operation of the *single microscope*. When the image *mn* is distinctly formed on paper, the lens LL acts as in the *camera obscura*, painting all objects before it in their natural colours, in their just proportions, and with all their movements, on a white ground placed behind it. When the image *mn* has become greater than the object MN, by the advance of the latter to the lens, the eye views this magnified picture, and the effect is the same as in the *compound microscope*, whose object-glass is LL, and whose eye-glass has a focal distance equal to that of the eye. When the image is infinitely distant, and the rays enter the eye parallel, the object being then in the anterior principal focus of the lens LL, and the eye behind it, the lens is then acting as a *single microscope*.

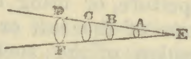
When objects are within our reach, such as microscopic objects, or near objects presented before a camera obscura, it is always in our power to illuminate them with artificial light, and thus make dark objects give brighter images; but when this cannot be done, in consequence of the objects being out of our reach, we can increase the brightness of the image by increasing the area or superficies of the lens. If the area of the lens LL, for example, were doubled, it would collect twice the quantity of rays that flow from every point of an object, and concentrate them at the corresponding points of the image *mn*.

In order to understand the principle of the *telescope* and *single microscope*, we must be acquainted with what is

Dioptrics.

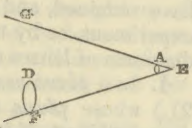
called the *apparent magnitudes* of objects. If we hold a sixpence A at the distance of six or eight inches from the eye E, then it will exactly cover or appear equal to a shilling placed at B, a half-crown placed at C, and a crown at D. If we remove the sixpence A, the shilling will just cover the half-crown. If we remove the shilling, the half-crown will just cover the crown. Hence all these coins placed as they are in the figure, are said to have to an eye placed at E the same apparent magnitude, because they are all seen under the same angle DEF, and would all cover the same portion of the sky, or of any distant object.

Fig. 43.



If the sixpence A is brought thrice as near the eye E as in fig. 44, its angle of apparent magnitude will now be GEF thrice as great as DEF, fig. 43, and it will appear thrice as large as DF. The sixpence has therefore been magnified; and if we interpose a lens between it and the eye, so as to make the rays refracted by the lens parallel, it will appear distinctly *magnified*, and the lens which we interpose will be a single microscope.

Fig. 44.



Objects within our reach, and capable of being placed where we please, may be therefore magnified to any extent, by placing them very near the eye, and in the anterior focus of a small convex glass, which, by making the diverging rays parallel, render the object as distinctly seen under a great angle, as if it were a large object placed at a distance, and subtending the same angle at the eye.

But when objects are at a distance, and beyond our reach, such as remote terrestrial objects, and the planets and stars, we can magnify them, or represent them to our eye under a greater angle of apparent magnitude, by a different principle. If the object is the dial-plate of a clock, at the distance of 12,000 feet, we place a lens whose focal distance is *six* feet, in the end of a tube about six feet long, and having directed it to the dial-plate, a distinct inverted image of the dial-plate will be formed in the focus of the lens, at a distance of six feet from it, and if we view this image with our eye placed six inches behind it, we shall see the image of the dial-plate distinct and magnified. Now, as the distance of the dial-plate is 12,000 feet, and that of the image only *six* feet from the lens, the image will be $\frac{12,000}{6}$, or 2000 times smaller in diameter than the object, not in apparent magnitude, but by real measurement; and if we were to take the image and place it beside the dial-plate, and view them both at the distance of 12,000 feet, their apparent magnitudes would, like their real magnitudes, be in the proportion of 2000 to 1. But the image is fortunately within our reach, and we can do with it what we choose. Let us first view it with the naked eye, which, generally speaking, sees objects most distinctly at a distance of six inches, and as we see it at the distance of six inches, it will appear as much greater as it would have done at the distance of 12,000 feet, as 12,000 feet is to six inches, or as 24,000 is to 1. Hence it follows, that though the image is diminished in the focus of the lens 2000 times, yet it is magnified from its proximity to the eye 24,000 times, that is, it is magnified on the whole $\frac{24,000}{2000}$, or *twelve* times. Now, this magnifying effect will be found under all circumstances to be equal to the focal length of the lens employed, divided by the focal distance of the eye, or the distance at which it sees small objects most distinctly, which is six inches, that is, in the present case $\frac{\text{six feet}}{\text{six inches}}$, or $\frac{72 \text{ inches}}{6 \text{ inches}}$, or *twelve* times. A short-sighted person, whose eyes have a focus of only three inches, would be able to see the same image of the dial-plate at the distance of *three* inches, and in his case the magnified effect would be $\frac{72 \text{ inches}}{3 \text{ inches}}$, or 24 times, and an old person, or one whose eyes were long-sighted, so as not to be able to see objects distinctly, nearer than 12 inches, would see the dial-plate magnified only six times. But both these persons could put on highly magnifying spectacles, so as to see the image at very short distances, or what is the same thing, to look at the image of the dial-plate through a magnifying glass, which would enable them to see it at the distance of one inch. In this case the magnifying effect would be $\frac{72}{1}$, or 72 times.

Telescopes

But the instrument which we have now fitted up is precisely a telescope, the large lens being its object-glass, and the small one used by the observer its eye-glass, and hence the magnifying power of such an instrument is always equal to the focal length of the object-glass divided by the focal length of the eye-glass. The image formed by such a telescope is inverted, which is of no consequence when we look at the heavenly bodies, and it is therefore called an *astronomical telescope;* but in looking at the dial-plate, and at terrestrial objects, the inversion would be disagreeable, and it is therefore usual to make the image erect, by using either a *concave* eye-glass, or three or more convex eye-glasses. In the former case it is called the *Galilean telescope*, and in the latter a *terrestrial telescope.*

When the distance of the object is not very great, or when the focal length of the lens bears a considerable proportion to the distance of the object, the magnifying power of a lens, when the eye views the image formed by the lens at the distance of six inches, is the following. Subtract the focal distance of the lens in feet from the distance between the image and the object, and divide the remainder by the same focal distance. By this quotient divide twice the distance of the object in feet, and the quotient will express the magnifying power, or the number of times that the object has been increased in apparent magnitude by the lens.

The very same observations apply to images formed by concave mirrors, and hence a single concave mirror becomes the simplest form of the reflecting telescope, the eye viewing the image which it forms. In the case of such images the body or the head of the observer must be placed between the object and the image, so that in order to use a single concave mirror, we must either make the mirror so large that the observer's head will not obstruct all the light, or we must make the reflexion a little obliquely, or, what is done in practice, we must by means of a small plane mirror or a prism reflect or refract the rays to one side, so as to allow the observer to look at the image formed by the concave mirror, without obstructing the rays in their passage from the object to the mirror, the quantity obstructed by the plane mirror or prism being too small to do any injury. If we view the image through a convex lens, so as to magnify it still more, the mirror and the lens will constitute a *reflecting telescope.*

PART III. ON SPHERICAL ABERRATION AND CAUSTIC CURVES.

Spherical aberration.

The rules which we have already given for finding the foci of lenses and mirrors, are strictly applicable only to rays that pass near the axis of the lenses and mirrors; and this may be readily proved by the method of finding the refracted and reflecting ray which we have explained and used.

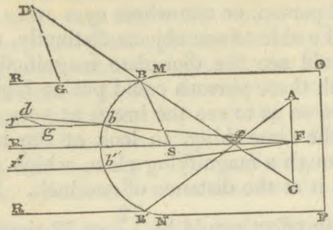
SECT I.—*On Spherical Aberration of Lenses.*

In order to prove and illustrate the preceding truth, we shall suppose parallel rays to be incident on a mass of glass MNOP, in which there is only refraction at its first surface, and we do this both to avoid the confusion of lines, and because it is perfectly sufficient for the purpose of explanation. Let RS be the axis of the spherical surface MN, passing

Spherical aberration.

through S, its centre of curvature; and if we consider it a ray, also, it will go on to F without any refraction. Let RB be a ray falling on the refracting surface at a distance from the axis RS, and parallel to it. From the point of incidence draw BS, which will be perpendicular to the surface at B, and take BG three fourths of BR, BG being to BR as 1 is to 1·500, the index of refraction. From G draw GD parallel to BS, and making BD equal to BR, through the points D and B, draw B*f*C for the refracted ray. Do the very same thing for the ray RB′ falling on the point B′, and parallel to RS, and equidistant from it, and B*f*A will be the refracted ray.

Fig. 45.



If we now take two rays *rb*, *r′b′* near the axis, and parallel to and equidistant from it, and apply the same method of projection to them, we shall find the refracted rays to be *b*F, *b′*F crossing the axis, and converging at a point F, more remote from the refracting surface than *f*. If we draw through F a line AEC, perpendicular to the axis, then A and C being the points where the marginal or most remote rays which fall on the surface MN, and F being the focus of those nearest the axis, the distance *f*F is called the *longitudinal spherical aberration*, and AC the *lateral spherical aberration* of the lens.

These results may be obtained experimentally by covering up with a circle of black paper, all the central parts of the spherical surface, leaving a clear marginal ring corresponding with BB′. If the surface thus limited is exposed to the solar rays, we shall find a pretty distinct picture or image of the sun formed at *f*, which, from a cause which we shall soon explain, will be highly coloured at the edges. If we now remove the black circle from the surface MN, and cover the outside surface with black paper, excepting a small opening in the vertex of the lens, where the axis RS cuts it, and expose the lens to the sun's rays, we shall find the image of the sun distinct at F, and it will be less coloured than the image formed at *f* from another cause.

If we now expose successive rings of the surface MN to the sun's light, shutting up all the rest of the lens, we shall find that the ring nearest the axis will have its focus near *f*, between *f* and F; the second ring, its focus still nearer F; the third, its focus still nearer F; and so on, till the last ring will give its image of the sun close to F. Hence it follows, that there will be distinct images of the sun formed by each ring, and occupying the whole space *f*F; and, therefore, if we expose the whole surface MN to the solar rays, the image of the sun must be extremely confused and indistinct; and if received upon a sheet of white paper placed at AC, it will consist of a bright disc at F, surrounded with a broad halo of light, becoming fainter and fainter towards A and C.[1]

As this is true of every spherical surface whatever, it follows, that every image formed by a spherical surface or lens, and every object seen through it, must be indistinct, from the confusion of rays produced by spherical aberration. As this indistinctness increases with the aperture of the lens, or the distance of the marginal rays from the axis, we may remove it to a certain degree by limiting the aperture, or using smaller lenses; but excepting in the case of the sun or any highly luminous body, this diminution of the aperture would injure vision, from the want of light, especially in microscopes and telescopes; and hence it becomes an object of the highest importance in optics, and it is one which has occupied much attention, to discover methods of diminishing or correcting the spherical aberration of lenses.

Spheric aberratio

Philosophers have, therefore, been led to calculate with accuracy the amount of spherical aberration in lenses of different forms, and having different sides exposed to the incident rays. The following are the results which they have obtained, and they may be readily verified either by experiment, or by tracing the refracted rays through large diagrams of lenses of different shapes.

Forms lenses least a greate aberrat

1. In a *plano-convex* lens, (such as that shewn at E, fig. 21.) whose *plane side is turned to parallel rays*, or to distant objects, if it is intended to form an image of them in its focus; or with its plane side turned to the eye, if it is to be employed as a single microscope or magnifier, the *spherical aberration* is $4\frac{1}{2}$ *times its thickness*, or the *greatest* that can be obtained from it. This is called its *worst* position.

2. In a *plano-convex* lens, whose *convex side is turned to parallel rays*, the spherical aberration is only $1\frac{17}{100}$ths of its thickness, or the *least* that can be obtained from it. This is called its *best* position.

3. In *double convex lenses* with equal convexities, the spherical aberration is $1\frac{67}{1000}$ths of their thickness, greater than that of a plano-convex lens in its best position.

4. In *double convex lenses*, having their radii as 2 to 5, the spherical aberration will be the same as in a *plano-convex* lens in its *worst position*, if the flattest side, or that which has its radius 5, is turned towards parallel rays; and it will be the same as that of a *plano-convex lens* in its *best position*, if the surface whose radius is 2 is turned to parallel rays.

5. The *lens of least spherical aberration* is a double convex one, the radii of whose surfaces are as 1 to 6, having the surface whose radius is 1 *turned towards parallel rays*. In this, which is its best position, the aberration is only $1\frac{7}{100}$ths of its thickness. But if the side with the radius 6 is turned towards parallel rays, the aberration will be $3\frac{45}{100}$ths of its thickness.

If we determine the virtual focus of the central and marginal rays for a concave surface, as in fig. 45, we shall find that the spherical aberration is exactly the same for *concave* as for *convex* lenses; and hence, all the preceding results are equally applicable to them.

If we suppose that the lens of least spherical aberration, as in art. 5, has an aberration expressed by unity, the comparative aberrations of other lenses will be as follows:

Double convex or concave with radii as 1 to 6, in *best position*....	1·000
Plano-convex or concave in *best position*....	1·081
Double equi-convex or equi-concave....	1·561
Plano-convex or concave in *worst position*....	4·206

[1] "The effect of aberration," says Sir John Herschel, "may be very prettily exhibited by covering a large convex lens with a paper screen full of small round holes, regularly disposed, and exposing it to the sun, receiving the converged rays on a white paper behind the lens, which should be first placed very near it, and then gradually withdrawn. The pencils which passed through the holes will form spots on the screen, and their disposition will become more and more unequal over the surface, as the screen is farther removed; those at the circumference becoming crowded together before the central ones. The manner in which the several spots corresponding to central rays blend together into an image at the focus, and those formed by the exterior ones are scattered round it, gives us a very good idea of the variation of density of the rays in the circle of aberration at or near the principal focus; and if the white screen be waved rapidly to and fro in the cone of rays, so as to pass over the focus at each oscillation, the whole cone will be seen as a solid figure in the air, and the place of the circle of least aberration will become evident to the eye, forming altogether a very pleasing and instructive experiment." *Treatise on Light*, § 317.

As a general rule for all lenses already made, and whose focus it is inconvenient to alter, the *most convex surface* should always be placed *towards parallel rays* when the lenses are used singly.

The preceding results are calculated on the supposition, that the lens is made of glass, whose index of refraction is 1·500; but the numerical results vary greatly when we use transparent media of higher and lower refractive powers. When the index of refraction, for example, is 1·6861, which is nearly that of some of the metallic glasses, and of several precious stones, and of sulphuret of carbon nearly, the lens of *least spherical aberration*, is not one which has its radii as 1 to 6, but one which is *plano-convex;* and when we come to higher refractive powers, such as those of *sapphire, ruby, garnet* and *diamond*, of which lenses are now made for microscopes, and ought to be made for the eye-glasses of powerful telescopes, one of the surfaces of the lens of least spherical aberration must be concave. This will be seen from the following results which we have calculated from Sir John Herschel's Formula,[1] viz. $\frac{R''}{R'}=\frac{2\mu^2-\mu-4}{2\mu^2+\mu}$ where R″ and R′ are the radii of the surfaces of the lens of least spherical aberration, and μ the index of refraction.[2]

	Index of Refraction.	Ratio.
Vacuum	1·000...1	to 1·00 equi-convex.
Tabasheer	1·100...1	to 1·31
New fluid in amethyst	1·111...1	to 1·35
Second do. in topaz	1·200...1	to 1·76
Ice	1·300...1	to 2·43
—— Water	1·3368..1	to 2·77
Cryolite	1·350...1	to 2·93
Fluor spar	1·400...1	to 3·60
Plate glass	1·500...1	to 6·00
Quartz, Topaz	1·600...1	to 14·00
Chrysolite	1·686...1	to infinity, plano-convex.
Sulphuret of carbon	1·700...1	to —93 meniscus.
Garnet, Ruby	1·800...1	to —12
Glass—lead 2½, flint 1	1·900...1	to —7
Zircon	2·000...1	to —5
Diamond, Octohedrite	2·500...1	to —2·5
Chromate of lead	3·000...1	to —2·1
	3·500...1	to —1·6
	4·000...1	to —1·5 equal radii.
	infinite 1	to —1

But it is not merely the curvature of the lens of least aberration that changes its character and its magnitude,—the aberration itself suffers a very great variation. This will appear from the table already referred to in our article Microscope; but we shall repeat that part of it which shews the amount of this change of the aberration, as the index of refraction changes from 1·4 to 2·0.

	Index of refraction.	Spherical aberration when least in parts of the thickness of the lens, which is supposed 1.[3]
Fluor spar	1·4	1·096
Glass	1·5	1·071
Quartz	1·6	0·933
Epidote	1·7	0·666
Sapphire	1·8	0.357
Sulphate of Lead	1·9	0·166
Zircon	2·0	0·062

In the case of diamond the aberration must be next to nothing; but in order to obtain this great advantage, its second surface must be very concave, which diminishes greatly its magnifying power. We have no doubt that artificial glasses or other solids will yet be made by art, and that mineral bodies will be discovered which will have such a high refractive power, as to enable opticians to remove almost wholly the spherical aberration of single lenses.

Spherical aberration.

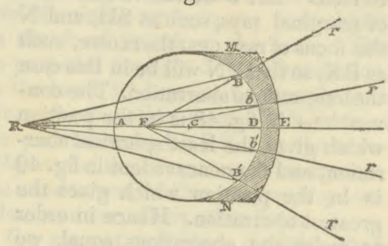
Aberration of rays not parallel.

Hitherto we have spoken only of the aberration of parallel rays, the effect of which is invariably to shorten the focus of the marginal or exterior rays; but when the incident rays converge or diverge, the aberration diminishes, and the focus of the marginal rays continues to be nearer the surface than that of central rays, till the focus of convergence or divergence comes up to *two particular points in the axis*, at the first of which, as will be presently seen, the aberration disappears, and at the second of which, namely, the focus of parallel rays in the convex side, it is infinite. When the focus of convergence or divergence is situated between these points, the effect of aberration is to lengthen the focus of marginal rays, and shorten that of central rays, the focal distance of the latter being now shorter than that of the former. These results are true for all curvatures and all indices of refraction.[4]

Sir John Herschel has given the following general rule for all double convex or concave lenses, and for all meniscuses and concavo-convex lenses in which the sum of the curvatures of their surfaces is greater than $\sqrt{2\mu+3\mu^2}$ times their difference, (μ being their index of refraction.) *The effect of aberration will be to throw the focus of marginal rays more* TOWARDS the incident light *than that of central ones, when the lens is of a positive character, or makes parallel rays converge; but more* FROM *the incident light if of a negative character, or if it cause parallel rays to diverge.*[5]

We have mentioned above, that there is a point in the axis, at which rays which diverge from it, and fall upon a concave surface, will have no spherical aberration. This will be understood from fig. 46, where BB′ is the first concave surface of a medium, C its centre, RCD its axis, and A a point in the spherical surface, where it meets the axis beyond the centre C. If we take two points R, F, such that RC is equal to the radius AC of the surface multiplied by the index of refraction, or RA to AF as the index of refraction is to unity, then all rays diverging from R, whether marginal or central, and falling upon the concave surface BDB′, will be refracted at BB′ in directions Br, B′r, which will proceed from the virtual focus F without any spherical aberration. This may be readily proved by the projection of the rays. Hence if upon F as a centre with any radius FE greater than FD, we describe a circle MEN, we shall have the second surface of a concavo-convex lens, which will be entirely free of spherical aberration. This is evident, as the rays refracted by the first surface BDB′ fall perpendicularly on the second surface, and suffer therefore no refraction.

Fig. 46.



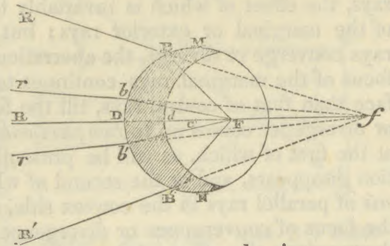
As there is a *concavo-convex lens* without aberration, for rays diverging from one point of its axis r, so there is a *meniscus* without aberration for rays converging to a particular point in its axis. Let RB, R′B′ be rays converging to a point f in the axis RCf of a convex refracting surface BDB′, whose centre is C. If we take fc, so that it is to the radius CD as the index of refraction is to unity, then it may be shewn by projection or calculation that the refracted rays RB, rb, whether marginal or central, will be refracted in lines BF, bf having the same focus F without any spherical aberration. Hence if with F as a centre we describe

[1] *Phil. Trans.*
[2] See our article Microscope for a table of the results obtained by Mr. Coddington, from indices of refraction from 1·4 up to 2·0.
[3] These aberrations are computed by Mr. Coddington.
[4] Sir John Herschel's *Treatise on Light*, § 288.
[5] *Id.* 299.

Spherical aberration.

any circle, having its radius Fd less than FD, we shall have the second or concave surface of a meniscus, which will have no aberration, because the rays BF, bF will pass through that surface perpendicularly, and suffer no refraction.

Fig. 47.



Owing to the injurious effect of spherical aberration on the performance of telescopes and compound microscopes, philosophers have sought to correct the spherical aberration of convex lenses, by the opposite aberration of concave ones. We have already given drawings[1] of three doublets without spherical aberration, according to the calculations of Sir John Herschel; and we shall now give an account of the method used by Dr. Blair of correcting the spherical aberration in his compound object-glasses, and as they possess some historical interest, we shall give the same diagrams which he employed. Let AB, fig. 48, represent a convex lens receiving a pencil of diverging rays from the object S, and let D be the focus of marginal and F that of rays incident near the axis, such as ST. The greatest longitudinal aberration will therefore in this case be DF. Let GH, fig. 49, be now a concave lens, upon which are incident parallel rays SHRK. Let P be the virtual focus of marginal rays, such as SH, and N the focus of rays near the centre, such as RK, so that PN will be in this case the longitudinal aberration. The convex lens in fig. 48 is in the position which gives the least spherical aberration, and the concave lens in fig. 49 is in the position which gives the greatest aberration. Hence in order to make the aberrations equal, we must make the focal distance of the convex glass much shorter than that of the concave one, and if it is requisite to have the distance of the points F and N from the convex and concave lenses the same as it is shewn in the figures, the object must then be placed much nearer the convex lens. Hence the image of the near object S is placed at the same distance from the convex lens in fig. 48, or the virtual focus of the concave lens in fig. 49, where it is shewn as refracting parallel or infinitely distant rays.

Fig. 48.

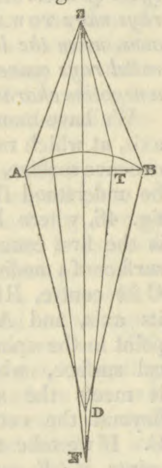
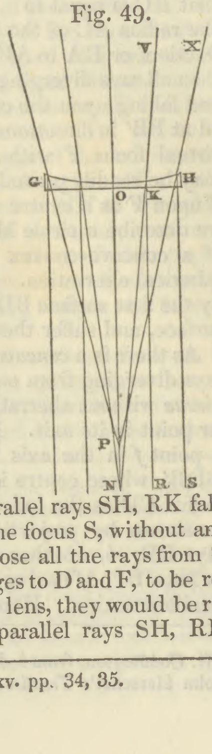
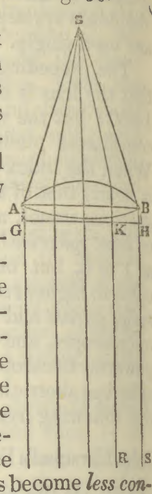


Fig. 49.



When the focal distance KN, therefore, for parallel rays is equal to the distance TF for rays diverging from S, and when the aberration DF and PN are equal, then if the two lenses are combined, as in fig. 50, parallel rays SH, RK falling upon them, will be refracted to the focus S, without any spherical aberration. For if we suppose all the rays from S, which the convex lens, fig. 48, converges to D and F, to be returned back from these points to the lens, they would be refracted accurately to S. But the parallel rays SH, RK, after refraction by the concave lens, fig. 49, in the directions HX, KV, are exactly in the same relative situation as the rays which we have supposed to be returned directly back from F and D are in at their incidence on the convex lens. Hence when these lenses are combined, as in fig. 50, parallel rays falling on the concave lens, and after refraction incident upon the convex lens, will be refracted accurately to S without any spherical aberration.[2]

Fig. 50.

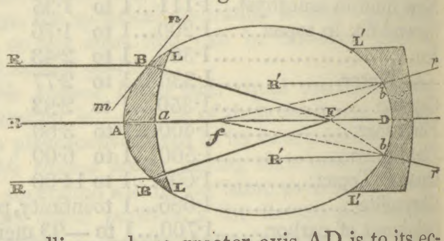


Spherical aberration.

The difficulty of getting rid of the aberration of spherical surfaces, induced opticians at a very early period to propose the construction of lenses that were not spherical, and that had such forms as to be entirely free of spherical aberration. As the marginal parts of spherical lenses refract the rays which fall upon them too much, the spherical aberration would obviously be removed or diminished, by giving the surface any curvature, in which the marginal parts become *less convex*. Now, this is the character of two well known curves, viz. the ellipse and the hyperbola, which, as Descartes discovered, may be employed in the formation of lenses in the following manner:—

Lenses spherical

Fig. 51.

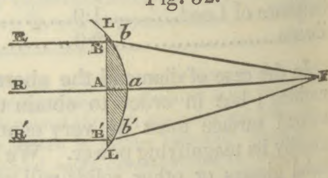


If a lens LL, fig. 51, has the form of a meniscus in which the convex surface LAL is part of a prolate spheroid formed by the revolution of an ellipse, whose greater axis AD is to its eccentricity or distance between its foci F, f as the index of refraction is to unity, and if the other surface LaL is concave, and part of a sphere whose centre is F, the remoter focus of the spheroid, then rays RB, RA, RB parallel to the axis RF of the spheroid or the ellipse will be refracted by the convex spheroidal surface alone to the remoter focus F, and as these rays fall perpendicularly upon the second surface LaL, they will suffer no change whatever by its action, and continue their progress to the focus F.

The same property belongs to a *concavo-convex* lens L′L′, whose anterior or concave surface is part of a prolate spheroid of the same dimensions as for the meniscus, and having its convex side of any radius. In this case, all rays R′b, R′b parallel to the axis and incident at b, b, will be made to diverge from the same virtual focus F, and will suffer no change of direction in passing out of the second or convex surface, as they all fall upon it perpendicularly.

These truths may be proved by the most elementary principles of the conic section, or by drawing a tangent *mn* to the elliptical surfaces at B, b, and determining the refracted rays by the method already described.

Fig. 52.



Upon the same principles a *plano-convex* lens may be constructed without spherical aberration, as shewn in fig. 52, provided its posterior surface LaL is part of a hyperboloid formed by the revolution of a hyperbola LaL, whose greater axis is to the distance between the foci as the index of refraction is to unity. Pa-

[1] Art. Microscope, vol. xv. pp. 34, 35.

[2] See *Edinburgh Transactions*, vol. iii. p. 27.

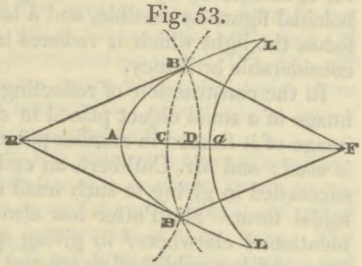
Spherical aberration.

rallel rays RB, RA, R′B′, will suffer no refraction at the plane surface BAB′, but at the points of the convex surface *b*, *b*′ will be refracted accurately to F, the further focus of the hyperboloid.

In like manner, a *plano-concave* lens having its concave surface part of a hyperboloid will diverge all rays so as to have their virtual focus in one of the foci of the hyperboloid.[1]

The following elegant method of determining the figure of a refracting surface which shall refract marginal and central rays to the same focus is due to Huygens. Let R be the focus of diverging rays, and F the focus to which it is required to refract them with accuracy. Take any point A as the vertex of the refracting surface required; the surface must be such that the incident and refracted rays RB, BF have such a ratio to each other, that the excess of RB above RA shall be to that of FA above FB, as the index of refraction is to unity. In order to find the curve BAB which possesses this property, take in the axis RF any point D, and let DA be divided at the point C in such a manner that AC is to AD as unity is to the index of refraction, and from R and F as centres, describe the arches of circles BDB′, BCB′, with the radii RD, FC, their points of intersection B, B′ will be in the required curve. In like manner, any other points in the curve may be found, and in order to convert it into a lens, we have only to describe a spherical surface L*a*L, round the focus F as a centre, so that the refracted rays BF, B′F may suffer no change by passing through it perpendicularly. The curve BAB gradually approaches to an ellipsoid as the radiant point R becomes more distant from the lens, and when it is infinitely distant, the curve is the section of an ellipsoid, whose further focus is in F.[2]

Fig. 53.



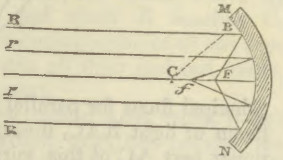
Various attempts have been made to execute lenses of other forms than spherical, but without decided success. Descartes has described machines for this purpose in the *tenth* chapter of his Dioptrics, but though he succeeded to a certain degree in his experiments, yet the art has never been acquired of producing figures sufficiently accurate for fine telescopes and microscopes.

Sect. II.—*Spherical Aberration of Mirrors.*

It has already been stated under *Catoptrics* in this article, that in all reflexions from spherical surfaces it is only for the ray near the axis that the rules for finding their foci are correct, those which fall farther and farther from the axis having their foci nearer the reflecting surface. Hence all the images which are formed by spherical surfaces are indistinct from spherical aberration, like those formed by lenses, with this difference, that the images are not confused with the different colours which always accompany the refraction of lenses.

If MN, fig. 54, is a concave mirror, by which parallel rays RR are reflected from its margin and *r*, *r*, from near its axis, it will be found from a simple projection of the reflected rays that R, R will invariably be reflected to a focus F nearer the mirror than the focus *f* of the central rays. The space F*f* is called the longitudinal or linear spherical aberration, and it will obviously become greater as the diameter of the mirror is increased, its focal length or its curvature remaining the same, and with its curvature when its diameter or aperture remains the same.

Fig. 54.

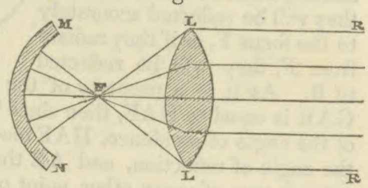


In all cases but *one*, the marginal rays have a shorter focus than the central ones, or what is the same, have their focus nearest the reflecting surface. This case takes place when the radiant point is situated between the surface and the principal focus on the *concave* side of the mirror, in which case the focus of marginal rays is *farther from* the mirror than that of central rays.

There are only *two* cases in which spherical reflecting surfaces have *no* spherical aberration, namely, when diverging rays radiate from the centre of a concave mirror or spherical surface, in which case they are reflected back without aberration to the point from which they came, without any aberration, and when they converge to the centre of a convex mirror or spherical surface, in which case they will be reflected back in lines diverging from the centre or virtual focus behind it without any aberration.

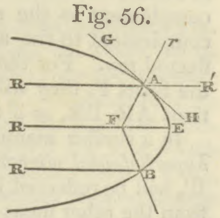
One of these cases, namely, the first, is not an ideal one, but is actually applicable to practical purposes. For example, if rays diverging from F the centre of curvature, (not the focus) of the reflecting mirror MN, fall upon the mirror, they will be reflected to F, and pass through F towards a lens LL, which will refract them into a parallel beam LLRR; if FL is the focal length of the lens, or into a converging beam, so as to illuminate strongly any near object, if FL is greater than the focal length of the lens. This contrivance has been proposed for light-house illumination, where, in addition to the beam FLL radiating directly from F the lens LL, receives also the other beam FMN, both of which it unites in one parallel beam LLRR. In the accurate illumination of objects for the microscope, this contrivance is also applicable; and hence for this purpose a *spherical* mirror is better than a mirror of any other form.

Fig. 55.



As we cannot in the case of reflectors diminish their spherical aberration as we did in lenses, by giving a different shape to the two surfaces, it becomes of great importance to form the reflecting surface in such a manner as to remove the spherical aberration altogether. It is evident from the inspection of fig. 54, where CB is a perpendicular to the mirror at B, RMC the angle of incidence, and CBF the angle of reflexion, that if the reflecting surface should be such that the line BF drawn to a fixed point, F should always form equal angles with a line CB perpendicular to the mirror at the point of incidence, the parallel rays would all converge to the point F. Now the *parabola* is a curve which possesses this property as shewn in fig. 56. Let AEB be a parabola which form a reflecting surface by its revolution round its axis RFE, and let R, R, R be parallel rays incident upon the paraboloidal surface at the points A, E, B. Then if F is the focus of the parabola, and GH a line touching the curve at A, it is a property of the parabola,[3] that the angle GAR is equal to HAF, but GAR is the complement of the angle of incidence, and therefore HAF will be the complement of the angle of reflexion, and

Fig. 56.



[1] See Descartes' *Dioptrica*, cap. viii.
[2] See Newton's *Lectiones Opticæ*, part i sec. iv. and Huygen's *Traite de la Lumière*, p. 111, &c. &c.
[3] See Conic Sections, vol. vii. p. 222, prop. iii. cor. 3.

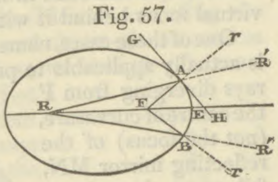
Spherical aberration.

consequently AF the reflected ray. As this is true for every ray parallel to the axis RFE, it follows that all parallel rays incident upon the surface of a paraboloidal mirror will be reflected accurately to the focus of the paraboloid.

It may be shewn, in like manner, that *convex paraboloidal reflectors* will reflect parallel rays, so as to make them diverge from the virtual focus of the paraboloid. If, in fig. 56, we continue the line RA to R, and also FA to rC, it follows, from the above reasoning, that R′AH is equal to raC, and that the reflected ray is Ar, diverging accurately from the focus F.

When we wish to reflect diverging rays to a focus, without aberration, we must have recourse to another solid of revolution, namely, a prolate spheroidal surface formed by the revolution of an ellipse round its greater axis. In this case, rays diverging from one of its foci will be reflected accurately, without aberration, to the focus F. This will be understood from fig. 57, where R, F are the foci of an ellipsoid, AEB a section of the ellipsoidal surface, and GH a line touching the ellipse at A; then if rays diverging from one of its foci R, fall upon the reflecting surface at A, E, and B, they will be reflected accurately to the focus F, or if they radiate from F, they will be reflected to R. As it is a property of the ellipse,[1] that the angle GAR is equal to HAF, then since GAR is the complement of the angle of incidence, HAF must be the complement of the angle of reflection, and AE the reflected ray. As the same is true of every other point of the ellipsoidal surface, it follows that all rays incident upon it from one focus, will be converged without aberration to the other focus.

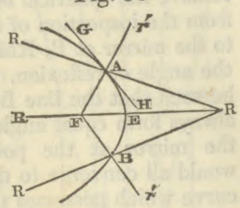
Fig. 57.



In like manner, it may be shewn, by producing RA to R′, and RB to R′, that rays falling upon a *convex ellipsoidal mirror*, and converging to one focus, will be reflected as if they diverged accurately from the other focus. That is, rays R′AR, R′BR, converging to R, will be reflected in diverging directions Ar, Br, as if they diverged from the focus F, or rays rA, rB converging to F, will be reflected in directions AR′, BR′, as if they diverged from R as their virtual focus.

If the concave surface of a mirror is a portion of a *hyperboloid*, a solid generated by the revolution of a hyperbola about its axis, rays converging to one focus will be reflected to the other focus. Let AEB be a section of the hyperboloid, and RAR, RBR′, rays converging to its focus; these rays will be reflected to its other focus F. Let GH be a tangent to the hyperbola at A, then by a well-known property of the hyperbola,[2] the angle GAR is equal to HAF; but the former being the complement to the angle of incidence, and the latter the complement to the angle of reflection, AF will be the reflected ray. For the same reason, if the rays *diverge* from the focus F, they will, after reflexion, diverge in the directions AR, BR, as if they came from the other focus R′.

Fig. 58.



In a similar manner, it may be shewn, that in a *convex hyperboloidal mirror* AEB, rays diverging from one focus R′, will be reflected in directions Ar, Br, as if they diverged from the other focus F.

The preceding truths are of great practical use in the construction of optical instruments. In all reflecting telescopes, where parallel rays are required to be reflected to a single focus, it is necessary that the figure of the reflecting surface should be that of a paraboloid; and as in the specula of such telescopes the portion of the paraboloid which is requisite, does not differ much from the same portion of a spherical surface that has the same focal length, artists have contrived particular methods by which the marginal parts of the spherical surface shall be worn down in the act of polishing, so as to convert the spherical into a paraboloidal surface.

In the reflectors of light-houses, where a large surface is required to be used, a copper plate thickly plated with silver is hammered by means of a gauge to as correct a paraboloidal figure as possible, and a lamp being placed in its focus, the light which it radiates is reflected in a beam of considerable brilliancy.

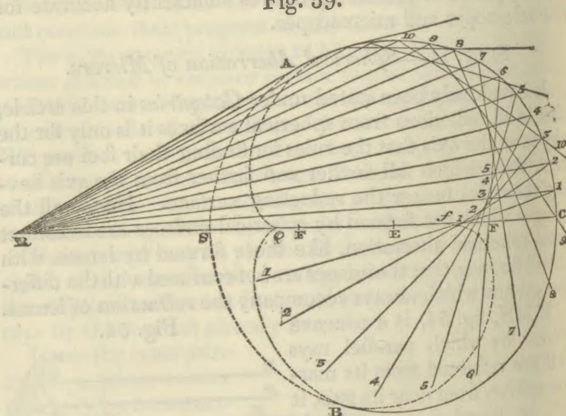
In the construction of reflecting microscopes, where the image of a small object placed in one spot has a magnified image of it formed in another point, an ellipsoidal speculum is used; and Mr. Cuthbert, an eminent London artist, has succeeded in giving to such small specula an accurate ellipsoidal form. Mr. Potter has also succeeded, as we have mentioned elsewhere,[3] in giving specula a true ellipsoidal form, and has published an account of the method by which he was able to effect this important object.[4]

SECT. III.—*On Caustic Curves formed by Spherical Reflecting and Refracting Surfaces.*

When two or more rays of light cross one another at any point, they illuminate any reflecting substance placed in that point with their united light. Hence it follows, that when spherical surfaces converge the rays which fall upon them to different foci, these different foci must form so many illuminated points, if they are received on smoke, on white paper, or on water with any reflecting particles suspended in it. The lines which pass through these luminous foci, or rather the lines formed by the union of a great number of them, are called *caustics*, or *caustic curves*. As these curves are in reality a visible representation of the phenomena of spherical aberration, they possess considerable interest, as experimental illustrations of that class of facts.

When diverging rays fall upon a spherical mirror, whose surface exceeds a hemisphere, the caustics formed by reflexion are exceedingly beautiful. Let ACB be the section of such a spherical surface, whose centre is C, and whose

Fig. 59.



principal focus for parallel and central rays is at f. Let a beam of light RAC, diverging from R, be incident on the upper part AC of this mirror, the beam consisting of the individual rays R1, R2, R3, &c., up to R10; and let the reflected rays 1, 1; 2, 2; 3, 3, &c., be found by making the angle of reflexion which they form with the perpendiculars

[1] See CONIC SECTIONS, vol. vii. p. 229, prop. v. cor. 4.
[2] Id. Id. p. 241, prop. v.
[3] Art. MICROSCOPE, vol. xv. p. 42.
[4] *Edin. Jour. of Science*, N. S., No. 12, p. 228.

drawn from 1, 2, 3, &c., to C, equal to the angles of incidence which they form with the same perpendiculars. We shall then have the directions, and also the foci and intersections of all the rays. The ray 10, 10 does not meet the axis RC at all, but falling on the mirror at the point 3, will there suffer a second reflexion. The ray 9, 9 has its focus exactly at C, the vertex of the mirror, where it will suffer a second reflexion, and so on with all the rest, up to 14, which is the last which will suffer a second reflexion. All the reflected rays, after 9, 9, cross the axis, or have their foci at points gradually approaching to f, which is the focus of the central ray R 1. As all the rays proceeding from R, but not drawn in the figure, which fall upon the other half CB of the mirror, at points corresponding to R 1, R 2, &c., will have their foci in the same points between C and f, there will be along that line a series of foci constituting a line of light becoming more intense towards f.

But the rays R 10, R 9, R 8, cross each other after reflexion, and before they reach the axis, as shewn in the figure, and hence there will be a beautiful curve of light Af, called a *caustic*, formed by the intersection of these rays. The other half of the mirror CB will form a similar caustic, and the projecting points f are called the *cusps* of these caustics, and Cf their tangent.

If a small pencil of light, consisting of two contiguous rays, moves from RA towards the position RB, being incident successively at 9, 8, 7, 6, &c., the conjugate focus of this pencil, or that formed by the intersection of the two rays of which it consists, will move along the caustic curve Af, while the points where it crosses the axis RC, or its focus formed by its union with a similar pencil similarly incident on the other half of the mirror, will advance from C to f.

If we now consider ACB as a *convex* spherical surface, and place the radiant point R as far to the right of the vertex C as it is to the left of it in the figure, and if we project the reflected rays, we shall find that when traced backwards, they will intersect the *axis* and each other, in the very same manner as they do in the figure, forming an *imaginary* or *virtual* caustic, in place of a *real* one, the two being in every respect the same.

If, while the radiant point R remains as in the figure, we suppose the convex surface ASB to receive the incident rays, it will then be found, by projecting the reflected rays, that they will form an imaginary caustic AφB, less than AfB, and joining it at the points A, B. This difference in size arises from the radiant point being in this case much nearer the convex surface than before.

Let us now suppose that the radiant point R recedes from the *concave* mirror ACB, the point f of the *cusps* will gradually approach to F, the tangent Cf diminishing at the same time; and when R is infinitely distant, or the rays parallel, the point f will coincide with F, the focus of parallel rays. The same will take place in the case of the *convex* mirror ACB; but in the case of the convex mirror ASB, the point φ of the cusps will approach to F′, and will coincide with it when R is infinitely distant.

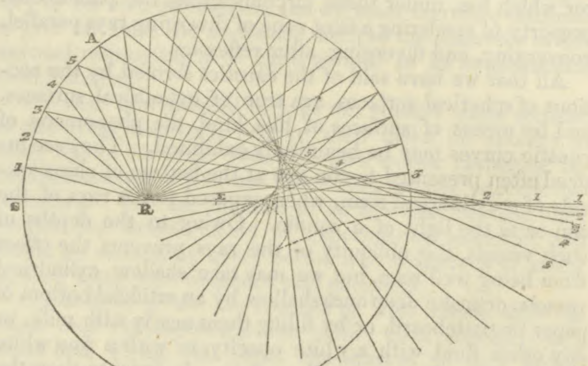
If, in the case of the *concave mirror* ACB, the radiant point R now approaches to the mirror, the cusps f will approach to the centre E of the mirror, the *caustic* curve Af becoming flatter and flatter, and when R reaches C, there will be no caustic at all, in consequence of all the rays being reflected back to the centre, all their *foci* and *intersections* having united in that point.

In the case of the *imaginary* caustic AφB, when R approaches to S, φ will also approach to S, the caustic approximating in form to the circular arch AS; and when R reaches S, φ will also reach S, the caustic disappearing when it has reached that limiting form.

All that we have said is obviously applicable only to one section of the spherical mirror; but as the same is true of every section whatever, the caustic will not be a curve, but a surface formed by the revolution of the curves AfB round its axis fC, all the reflected rays being tangents to this surface.

We shall now consider the change in the appearance of the caustic, when the radiant point comes within the sphere of which the reflecting surface is a part, and when the mirror becomes a concave polished sphere. The effect thus produced is shewn in fig. 60, RE being less than RS′. In this case a remarkable double caustic will be formed, com-

Fig. 60.



posed of a short one of the kind shewn in fig. 59, and another with two long branches, one of which is shewn at 1, 2, 3, 4, 5, the dotted line below the axis SE shewing the other halves of the caustic, the long branches converging behind the mirror. Had R been placed nearer S than E, the branches 1, 2, 3, &c., would have diverged behind the mirror, having their virtual foci within the mirror. When R is half-way between S and E, the curved branches become parallel lines. When R comes nearer E the branches 1, 2, 3, &c., shorten; the smaller caustics also shorten; they both approach to the centre E, the long branches moving quickest till at E, as we have already seen, all the rays from R are reflected back to the same point, and the caustics all disappear.

M. A. Delarive, in his ingenious dissertation on caustic curves,[1] has shewn that caustics generated by parallel rays are *epicycloids*, formed by one circle rolling upon a fixed circle concentric with that of the mirror, and having a radius equal to half of its own. Dr. Smith has shewn that when the radiant point is at S, the caustic is an epicycloid, whose generating circle is two-thirds of the radius of the mirror, and the fixed circle one-third of that radius.[2]

When the radiant point passes the centre E, the caustics shift their place to the opposite side of E, and present the same phenomena as before.

There is a curious property, however, involved in these phenomena, which we have represented in fig. 61, where the radiant point is supposed to be at F, a very little within the principal focus of a spherical mirror ACB. We have supposed the rays to diverge from a point *a little* within the principal focus, because it is only in this case that the rays F 1, F 1, at *a little* distance from the axis, may be reflected in directions 1, 1, 1, 1, exactly parallel. The rays F 2, F 2, falling at a greater distance from the axis, will be made to converge to a focus at f 2,

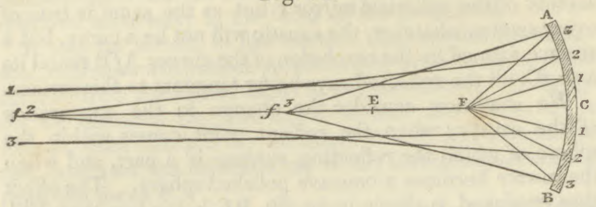
[1] *Dissertation sur la Partie de l'Optique qui traite des courbes dites Caustiques*, p. 84. Geneve, 1823. This interesting dissertation contains an account of the labours of preceding mathematicians, including Malus and Gergonne, and merits the attention of those who wish to prosecute the subject mathematically.

[2] *Complete System of Optics*, vol. i. p. 174.

Caustics.

and rays F 3, F 3, to a focus f 3, still nearer the mirror. If we now conceive rays flowing from F to fall on the mirror

Fig. 61.



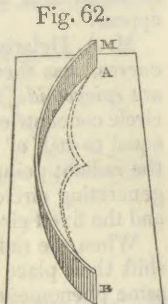
between the rays F 1, F 1, and the axis FC, these rays will diverge, because they radiate from a point a little within the principal focus, and hence we have one spherical mirror which has, under these circumstances, the paradoxical property of rendering a faint cone of diverging rays parallel, converging, and diverging, after reflexion.

Caustics from cylindrical surfaces.

All that we have said of the caustics formed by the sections of spherical surfaces, are true of cylindrical surfaces, and by means of surfaces of this kind, the phenomena of caustic curves may be beautifully exhibited. They are indeed often presented to the eye at the bottom of china vessels of a cylindrical form, when exposed to the rays of the sun or to the light of a candle. Owing to the depths of such vessels, the obliquity of the rays prevents the effect from being well seen, but we may take shallow cylindrical vessels, or make deep ones shallow by an artificial bottom of paper or pasteboard, or by filling them nearly with milk, or any other fluid with a white opacity, or with a fine white powder pressed into a smooth surface. In order to shew the caustics, when the radiant point is placed within the cylindrical surface, a piece of card should be made to float upon oil in the cylindrical vessel, and a very minute wick inserted in the card at the points of the axis where we wish the radiant point to be placed. This wick, when lighted, will be the radiant point R in fig. 60, and the caustics will be beautifully formed on the surface of the white card.

The following method, however, of exhibiting caustic curves, we have found very convenient and instructive, and it has the advantage of allowing the radiant point to come within the cylinder. A piece of steel-spring highly polished, such as a watch-spring, is bent into a concave form, like AB, fig. 62, and is placed vertically with its lower edge resting upon a piece of card or white paper. It is then exposed to the solar rays, or those of any artificial light, so that the plane of the card MN passes through the luminous body, and the caustic curves will be seen finely displayed, varying with the distance of the radiant point, and with the reflecting arch AB. By altering too the curvature of the arch and bending it into different known curves, either by applying a portion of its breadth to the required curves delineated upon a piece of wood, and either cut or burned sufficiently deep in the wood to allow the edge of the thin strip of metal to be inserted in it, a great variety of interesting phenomena may be observed. The brightest reflector is a thin strip of polished silver or plated copper. Gold and silver foil will also answer, or a strip of mica. A cylindrical section of a wide glass tube or a bottle, especially if a piece is cut out of them to allow the incident rays to pass to the reflecting surface in the plane nearly of the base of the cylinder, will produce the caustic curves in great perfection. The caustic curves produced by a highly gilt or polished metallic ring, such as the ring of a bell handle, are exceedingly beautiful, the phenomena of a convex and a concave surface being here united.

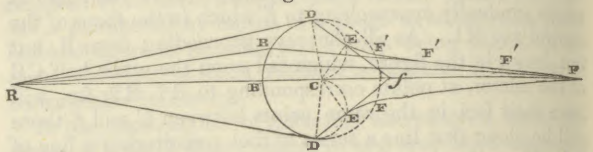
Fig. 62.



Caustics formed by Refracting Surfaces.

It is evident, from what has been said of caustics formed by reflexion or *Catacaustics*, that analogous curves must also be formed by spherical refracting surfaces, which has been called *Diacaustics*. In order to explain these curves, we shall take the case of diverging rays falling upon a spherical surface, as shewn in fig. 63. where DBDF is the spherical surface, C its centre, R the radiant point, RD, RD

Fig. 63.



two extreme rays touching the sphere, and refracted in the directions Df; Df, and RB, RB other rays nearer the axis, and refracted in the directions BF, BF. If we join CD, CD, and drawing the semicircles DEC, DEC make the lines DE, CE′ in the same proportion to CD as unity is to the index of refraction, the caustic will begin at EE′ and extending in the directions E, F′, F will approach to the axis RC till it meets it at the principal focus F.

The caustics formed by the two refractions of a sphere, or of a cylinder (in a plane perpendicular to its axis) are shewn in fig. 64, where ACB is the spherical section, E its

Fig. 64.

centre, R the radiant point, and RC the ray which touches the spherical surface. This ray will be refracted by the first surface in the direction 6,6, and by the second surface of the sphere at 6, the other rays R5, R4, &c. will be all refracted in the directions indicated by the numerals 5, 4, &c. and their various intersections will form the caustic 6, 4, 3, 2, 1, f, each ray crossing the next ray before it cuts the axis, f being the focus or the point where the rays nearest the axis cut it. The luminous figure bounded by the intersection of the successive rays, is composed of the two bright caustic curves. Within these caustics there is also much light arising from the intersections between the caustics and the axis; but as there are no intersections without the caustics they are bounded by absolute darkness.

When parallel rays fall upon the spherical section ACB, the caustic commences at the extremity of a diameter perpendicular to the axis of the section, because the extreme ray suffers refraction at that point, and will intersect the nearest a little within it, and they extend, as in fig. 64, to the principal focus of the sphere for rays near the axis. The real caustic will be the surface formed by the revolution of the curves round the axis Ef, the section of this curve will be a luminous point at f, but at the posterior surface it will be a luminous circle vividly depicted on the sphere. M. Delarive has pointed out a method of determining the index of refraction of solid spheres, or of hollow spheres containing different fluids, by measuring the diameter of this luminous circle, which is smaller in fluids of high than in those of low refractive power. The phenomena of caustics formed by refraction, may be distinctly exhibited by exposing to the rays of the sun, or a strong artificial light, a globe of glass filled with any fluid, or a solid transparent sphere, or the widest part of a round glass decanter. With all these bodies the whole of the luminous figure will be clearly seen. If we use a cylinder full of wa-

Chromatics.

ter, such as a tumbler or a cylindrical bottle, we shall see the caustic curves formed upon a white surface held parallel to the surface of the fluid, the light falling upon the cylindrical surface in the same plane.

PART II. ON THE REFRACTION OF COMPOUND LIGHT, OR THE DOCTRINE OF COLOURS AND THE PRISMATIC SPECTRUM.

In the preceding pages we have considered white light, whether emanating directly from the sun or from artificial flames, or consisting of the same rays reflected and modified by other bodies, *as a simple element* all the particles of which had the same index of refraction, or suffered the same change of direction when refracted by any transparent body. This, however, is not the nature of light. White light as emitted by the sun or other luminous bodies, is a very *compound element*, all the parts of which possess very different properties, and these properties are of a very remarkable and interesting kind. The power which causes the reflexion of light from polished metallic bodies is not capable of decomposing it, unless when it enters the substance of the metal; but the power which produces refraction is peculiarly influential in separating compound white light into its elements. The same decomposition may be effected by the *interference* of rays of light by *absorption*, and by another principle of analysis, which has been called *dissection.* The two first of these processes of analysis decompose compound light of different degrees of refrangibility; while the two last decompose compound light whose rays have the same refrangibility.

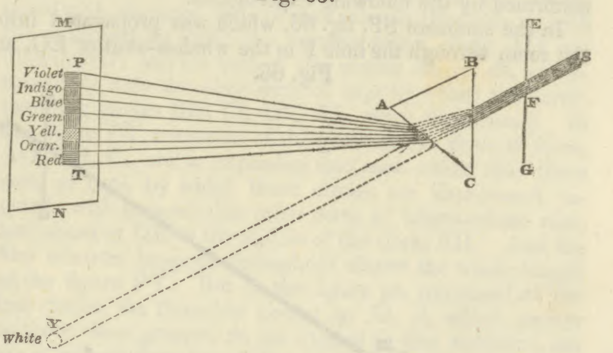
SECT. I.—*On the decomposition of light, and the different refrangibility of its rays.*

The constituent parts or colours which compose white light, are seven in number, *red, orange, yellow, green, blue, indigo,* and *violet.* These colours have been long observed and studied in the rainbow, and in the refractions produced by lenses and prisms, but till the time of Sir Isaac Newton, no satisfactory explanation had been given of their origin and properties. Descartes had found that colours similar to those of the rainbow were produced by prisms, and he endeavoured to explain them by saying, that the particles of the medium, or matter which transmits light, endeavour to revolve with so great force, that they cannot move in a straight line, whence comes refraction; and that those particles which endeavour to revolve more strongly produce a *red* colour, those that endeavour to move a little more strongly, produce *yellow*, and so on with the other colours. Now this explanation, as Mr. Whewell[1] has justly remarked, though it contains a gratuitous hypothesis respecting the cause of refraction, yet it proves that Descartes considered the different colours as produced by different degrees of refraction. In like manner Grimaldi, as the same author has observed, explains colours by saying, "that the colour is brighter where the light is dense; and the light is denser on the side from which the refraction turns the ray, because the *increments of refraction* are greater than the rays that are more inclined;"[2] that is, that the blue rays are more refracted than the red rays. We cannot agree, however, with Mr. Whewell in the opinion, that this explanation of Grimaldi's might give an explanation of most of the facts, but one much more erroneous than a development of Descartes's views would have been." It appears to us quite manifest, that both Descartes and Grimaldi had a vague sentiment that the different colours were produced by different degrees of refraction, and that Grimaldi's is the most distinctly expressed of the two; but we cannot for a moment agree with the author above quoted, "that Descartes was led very near the same point with Newton." The sentiments expressed by Descartes and Grimaldi, were mere notions of the moment, which authors often throw out without much thought, and which are employed in future times to pervert the history of science. If these two authors really thought that colours were produced by different degrees of refraction, why did they not, as they did other opinions, submit them to the test of an experiment, which required neither thought nor labour, and the means of making which were in their hands. Sir Isaac Newton was well acquainted with the writings of Descartes, and so much with Descartes's *notions* about colours, that the examination of them was the object which he had in view in purchasing his prisms. He never refers to them as anticipatory of his own discoveries, and we must therefore continue to give Sir Isaac the *undivided* merit of the discovery of the unequal refrangibility of light, as well as its experimental establishment.

We shall now proceed to give our readers some account of this great discovery, and we shall make no apology in doing this in Sir Isaac Newton's own words, abridging his descriptions where they are redundant, or have become unnecessary. We are induced to do this also, because they exhibit the finest model of experimental research, and should be studied by every person who is desirous of investigating truth with diligence and patience.

1. *The light of the sun consists of rays which differ in colour and refrangibility.*—In a very dark chamber, at a round hole F, fig. 65, about one-third of an inch broad,

Fig. 65.



made in the shutter of a window, I placed a glass prism ABC, whereby the beam of the sun's light, SF, which came in at that hole, might be refracted upwards, toward the opposite wall of the chamber, and there form a coloured image of the sun, represented at PT. The axis of the prism, was, in this and the following experiments, perpendicular to the incident rays. About this axis I turned the prism slowly, and saw the refracted or coloured image of the sun, first to descend, and then to ascend. Between the descent and ascent, when the image seemed stationary, I stopped the prism, and fixed it in that posture, for in that posture the refractions of the light at the two sides of the refracting angles, that is, at the entrance of the rays into the prism, and at their going out of it, are equal to one another.

Then I let the refracted light fall perpendicularly upon a sheet of white paper, MN, placed at the opposite wall of the chamber, and observed the figure and dimensions of the solar image, PT, formed on the paper by that light. This image was oblong, and not oval, but terminated by two rectilinear and parallel sides, and two semicircular ends. On its side it was bounded pretty distinctly; but on its ends very indistinctly, the light there vanishing by degrees. At

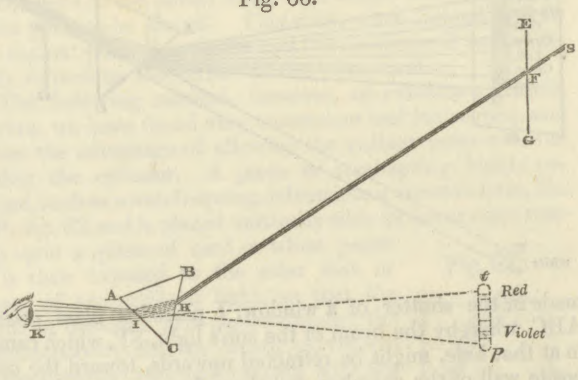
[1] *Hist. of Inductive Sciences*, vol. ii. p. 350. [2] Id. Id. p. 352.

the distance of $18\frac{1}{2}$ feet from the prism the breadth of the image was about $2\frac{1}{8}$ inches, but its length was about $10\frac{3}{4}$ inches, and the length of its rectilinear sides about 8 inches; and ACB, the refracting angle of the prism, by which so great a length was made, was 64 degrees. With a less angle the length of the image was less, the breadth remaining the same. It is also to be observed, that the rays went on in straight lines from the prism to the image, and therefore at their going out of the prism had all that inclination to one another from which the length of the image proceeded. This image PT was coloured, and the more eminent colours lay in this order from the bottom at T to the top at P; *red, orange, yellow, green, blue, indigo,* and *violet;* together with all their intermediate degrees in a continual succession perpetually varying."

Hence "the light of the sun consists of a mixture of several sorts of coloured rays, some of which at equal incidences are more refracted than others, and therefore are called *more refrangible.* The red at T, being nearest to the place Y, where the rays of the sun would go directly if the prism was taken away, is the least refracted of all the rays; and the *orange, yellow, green, blue, indigo,* and *violet,* are continually more and more refracted, as they are more and more diverted from the course of the direct light. For, when the prism is fixed in the posture above mentioned, so that the place of the image shall be the lowest possible, the figure of the image ought to be round, like the spot at Y, if all the rays that tended to it were equally refracted. Therefore, since it is found that this image is not round, but about five times longer than it is broad, it follows, that all the rays are not equally refracted. This conclusion is farther confirmed by the following experiments.

In the sunbeam SF, fig. 66, which was propagated into the room through the hole F in the window-shutter EG, at

Fig. 66.

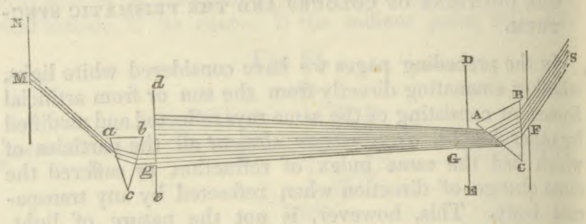


the distance of some feet from the hole, I held the prism ABC in such a posture, that its axis might be perpendicular to that beam: then I looked through the prism upon the hole F, and turning the prism to and fro about its axis to make the image *pt* of the hole ascend and descend, when between its two contrary motions it seemed stationary, I stopped the prism; in this situation of the prism, viewing through it the said hole F, I observed the length of its refracted image *pt* to be many times greater than its breadth; and that the *most refracted* part thereof appeared *violet* at *p;* the *least refracted* appeared *red* at *t;* and the *middle* parts *indigo, blue, green, yellow,* and *orange,* in order. The same thing happened when I removed the prism out of the sun's light, and looked through it upon the hole shining by the light of the clouds beyond it. And yet if the refractions of all the rays were equal according to one certain proportion of the sines of incidence and refraction, as is commonly supposed, the refracted image ought to have appeared round. So then by these two experiments, it appears that in equal incidences there is a considerable inequality of refractions."

Having discovered this fundamental property of light, he contrived the following experiment to prove it by ocular demonstration.

"In the middle of two thin boards DE, *de,* fig. 67, I made a round hole in each, at G and *g,* a third part of an inch in

Fig. 67.



diameter; and in the window-shutter a much larger hole being made at F, to let into my darkened chamber a large beam of the sun's light, I placed a prism, ABC, behind the shutter in that beam, to refract it towards the opposite wall; and close behind this prism I fixed one of the boards DE, in such a manner that the middle of the refracted light might pass through the hole made in it at G, and the rest be intercepted by the board. Then, at the distance of about twelve feet from the first board, I fixed the other board *de,* so that the middle of the refracted light, which came through the hole in the first board, and fell upon the opposite wall, might pass through the hole *g* in this other board *de,* and the rest being intercepted by the board, might paint upon it the coloured spectrum of the sun. And close behind this board I fixed another prism *abc,* to refract the light which came through the hole *g.* Then I returned speedily to the first prism ABC, and by turning it slowly to and fro about its axis, I caused the image which fell upon the second board *de* to move up and down upon that board, that all its parts might pass successively through the hole in that board, and fall upon the prism behind it. And in the mean time I noted the places *M, N,* on the opposite wall, to which that light after its refraction in the second prism did pass; and by the difference of the places at *M* and *N,* I found that the light, which, being most refracted in the first prism ABC, did go to the blue end of the image, was again more refracted by the second prism *abc,* than the light which went to the red end of that image. For when the lower part of the light which fell upon the second board *de,* was cast through the hole *g,* it went to a lower place M on the wall; and when the higher part of that light was cast through the same hole *g,* it went to a higher place N on the wall; and when any intermediate part of the light was cast through that hole, it went to some place in the wall between M and N. The unchanged position of the holes in the boards made the incidence of the rays upon the second prism to be the same in all cases. And yet in that common incidence some of the rays were more refracted and others less; and those were more refracted in this prism, which by a greater refraction in the first prism were more turned out of their way; and therefore, for their constancy of being more refracted, are deservedly called *more refrangible.*"

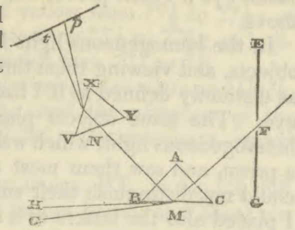
2. *The light of the sky, or the light of the sun reflected from the first surface of bodies, and also the white flames of all combustibles, whether direct or reflected, differ in colour and refrangibility, like the direct light of the sun.*

The truth stated in this proposition was established by Newton, by examining all those lights with a prism when they were faint, or transmitting them through the prism, as in section 1, when they were sufficiently intense.

3. *The light of the sun consists of rays differing in reflexibility; and those rays that are more refrangible than others are also more reflexible.*

A prism ABC, fig. 68, whose two angles at its base BC were equal to one another and half right ones, and the third at A a right one, I placed in a beam FM of the sun's light, let into a dark chamber through a hole F, one-third part of an inch broad; and turning the prism slowly about its axis until the light which went through one of its angles ACB, and was refracted by it to G and H, began to be reflected into the line MN by its base BC, at which till then it went out of the glass;

Fig. 68.



I observed that those rays as MH, which had suffered the greatest refraction, were sooner reflected than the rest. To make it evident that the rays which vanished at H were reflected into the beam MN, I made this beam pass through another prism VXY, and being refracted by it to fall afterwards upon a sheet of white paper *pt* placed at some distance behind it, and there by that refraction to paint the usual colours at *pt*. Then causing the first prism to be turned about its axis according to the order of the letters ABC, I observed that when those rays MH, which in this prism had suffered the greatest refraction, and appeared *blue* and *violet*, began to be totally reflected, the *blue* and *violet* light on the paper which was most refracted in the second prism received a sensible increase at *p*, above that of the red and yellow at *t*: and afterwards, when the rest of the light, which was *green*, *yellow*, and *red*, began to be totally reflected, and vanished at G, the light of those colours at *t*, on the paper *pt*, received as great an increase as the *violet* and *blue* had received before. Which puts it past dispute, that those rays became first of all totally reflected at the base BC, which before at equal incidences with the rest upon the base BC had suffered the greatest refraction. I do not here take any notice of any refractions made in the sides AC, AB, of the first prism, because the light enters almost perpendicularly at the first side, and goes out almost perpendicularly at the second; and therefore suffers none, or so little, that the angles of incidence at the base BC are not sensibly altered by it; especially if the angles of the prism at the base BC be each about 40°. For the rays FM begin to be totally reflected when the angle CMF is about 50°, and therefore they will then make a right angle of 90° with AC.

"It appears also from experiments, that the beam of light MN, reflected by the base of the prism, being augmented first by the more refrangible rays, and afterwards by the less refrangible, is composed of rays differently refrangible. The light whose rays are all alike refrangible, I call *simple, homogeneous* and *similar*; and that whose rays are some more refrangible than others, I call *compound, heterogeneous*, and *dissimilar*.

The colours of homogeneous lights I call *primary, homogeneous*, and *simple*; and those of heterogeneous lights, *heterogeneous* and *compound*. For these are always compounded of *homogeneous* lights.

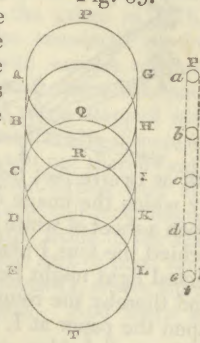
The *homogeneous* light and rays which appear *red*, or rather make objects appear so, I call *red-making*; those which make objects appear *yellow, green, blue*, and *violet*, I call *yellow-making, blue-making, violet-making*; and so of the rest. And if at any time I speak of light and rays as coloured or endowed with colours, I would be understood to speak not philosophically. For the rays, to speak properly, are not coloured, and in them there is nothing else than a certain power and disposition to produce a sensation of this or that colour."

4. *To separate from one another the heterogeneous rays of compound light.*

"That the rays which are equally refrangible fall upon a circle answering to the sun's apparent disk, will be proved by experiment by and by.

Let AG, fig. 69, represent the circle which all the most refrangible rays, propagated from the whole disk of the sun, will illuminate and paint upon the opposite wall if they were alone; EL the circle, which all the least refrangible rays would in like manner illuminate if they were alone; BH, CI, DK, the circles which so many intermediate rays would paint upon the wall, if they were singly propagated from the sun in successive order, the rest being intercepted; and conceive that there are other circles without number, which innumerable other intermediate sorts of rays would successively paint upon the wall, if the sun should successively emit every sort apart. And seeing the sun emits all these sorts at once, they must all together illuminate and paint innumerable equal circles; of all which being, according to their degrees of refrangibility, placed in order in a continual series, that oblong spectrum PT is composed, which was described in the first experiment.

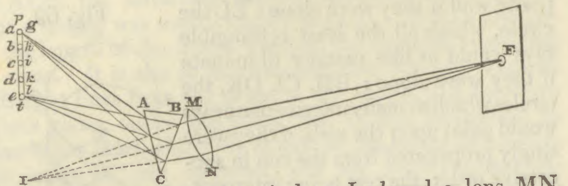
Fig. 69.



Now, if these circles, whilst their centres keep their distances and positions, could be made less in diameter, their interfering one with another, and consequently the mixture of the heterogeneous rays, would be proportionably diminished. Let the circles AG, BH, CI, &c. remain as before; and let *ag, bh, ci*, &c. be so many less circles lying in a like continual series, between two parallel right lines *ae*, and *gl*, with the same distance between their centres, and illuminated with the same sorts of rays: that is, the circle *ag* with the same sort by which the corresponding circle AG was illuminated; and the rest of the circles *bh, ci, dk, el*, respectively with the same sorts of rays by which the corresponding circles BH, CI, DK, EL, were illuminated. In the figure PT, composed of the great circles, three of those, AG, BH, CI, are so expanded into each other, that three sorts of rays, by which those circles are illuminated, together with innumerable other sorts of intermediate rays, are mixed at QR in the middle of the circle BH. And the like mixture happens throughout almost the whole length of the figure PT. But in the figure *pt*, composed of the less circles, the three less circles *ag, bh, ci*, which answer to those three greater, do not extend to one another; nor are there anywhere mingled so much as any two of the three sorts of rays by which those circles are illuminated, and which in the figure PT are all of them intermingled at QR. So then, if we would diminish the mixture of the rays, we are to diminish the diameters of the circles. Now these would be diminished if the sun's diameter, to which they answer, could be made less than it is, or (which comes to the same purpose) if without doors, at great distance from the prism towards the sun, some opaque body were placed with a round hole in the middle of it to intercept all the sun's light, except so much as coming from the middle of his body could pass through that hole to the prism. For so the circles AG, BH, and the rest, would not any longer answer to the whole disk of the sun, but only to that part of it which could be seen from the prism through that hole; that is, to the apparent magnitude of that hole viewed from the prism. But that these circles may answer more distinctly to that hole, a lens is to be placed by the prism to cast the image of the hole (that is, every one of the circles AG, BH, &c.) distinctly upon the paper at PT; after such a manner, as by a lens placed at a window the pictures of objects abroad are cast distinctly upon a paper within the room. If this be done, it will not be necessary to place that hole very far off, no, not beyond the window. And therefore, instead of that hole, I used the hole in the window-shutter as follows.

In the sun's light let into my darkened chamber through a small round hole, fig. 70, in my window-shutter, at about

Fig. 70.



ten or twelve feet from the window, I placed a lens MN, by which the image of the hole F might be distinctly cast upon a sheet of white paper placed at I. Then immediately behind the lens I placed a prism ABC, by which the trajected light might be refracted either upwards or sidewise, and thereby the round image which the lens alone did cast upon the paper at I, might be drawn out into a long one with parallel sides, as represented at *pt*. This oblong image I let fall upon another at about the same distance from the prism as the image at I, moving the paper either towards the prism or from it, until I found the just distance where the rectilinear sides of the images *pt* become most distinct. For in this case the circular images of the hole, which compose that image, after the manner that the circles *ag*, *bh*, *ci*, &c. do the figure *pt*, were terminated most distinctly, and therefore extended into one another the least that they could, and by consequence the mixture of the heterogeneous rays was now the least of all. The circles *ag*, *bh*, *ci*, &c. which compose the image *pt*, are each equal to the circle at I; and therefore, by diminishing the hole F, or by removing the lens farther from it, may be diminished at pleasure, whilst their centres keep the same distances from each other. Thus, by diminishing the breadth of the image *pt*, the circles of heterogeneal rays that compose it may be separated from each other as much as you please. Yet instead of the circular hole F, it is better to substitute an hole shaped like a parallelogram, with its length parallel to the length of the prism. For if this hole be an inch or two long, and but a tenth or twentieth part of an inch broad, or narrower, the light of the image *pt* will be as simple as before, or simpler; and the image being much broader, is therefore fitter to have experiments tried in its light than before."

5. *Homogeneal light is refracted regularly without any dilatation, splitting or shattering of the rays; and the confused vision of objects seen through refracting bodies by heterogeneous light, arises from the different refrangibility of several sorts of rays.*

In the middle of a black paper I made a round hole, about a fifth or a sixth part of an inch in diameter. Upon this part I caused the spectrum of homogeneous light, described in the former proposition, so to fall that some part of the light might pass through the hole in the paper. This transmitted part of the light I refracted with a prism placed behind the paper: and letting the refracted light fall perpendicularly upon a white paper, two or three feet distant from the prism, I found that the spectrum formed on the paper by this light was not oblong, as when it is made in the first experiment, by refracting the sun's compound light, but was, so far as I could judge by my eye, perfectly circular, the length being nowhere greater than the breadth; which shews that this light is refracted regularly without any dilatation of the rays, and is an ocular demonstration of the mathematical proposition mentioned above.

In the homogeneous light I placed a paper circle of a quarter of an inch in diameter; and in the sun's unrefracted, heterogeneous, white light, I placed another paper circle of the same bigness; and going from these papers to the distance of some feet, I viewed both circles through a prism. The circle illuminated by the sun's heterogeneous light appeared very oblong, as in the second experiment, the length being many times greater than the breadth. But the other circle, illuminated with homogeneous light, appeared circular, and distinctly defined, as when it is viewed by the naked eye; which proves the whole proposition mentioned above.

In the homogeneous light I placed flies and other minute objects, and viewing them through a prism I saw their parts as distinctly defined as if I had viewed them with the naked eye. The same objects placed in the sun's unrefracted heterogeneous light, which was white, I viewed also through a prism, and saw them most confusedly defined, so that I could not distinguish their smaller parts from one another. I placed also the letters of a small print one while in the homogeneous light, and then in the heterogeneous; and viewing them through a prism, they appeared in the latter case so confused and indistinct that I could not read them; but in the former, they appeared so distinct that I could read readily, and thought I saw them as distinct as when I viewed them with my naked eye: in both cases, I viewed the same object through the same prism, at the same distance from me, and in the same situation. There was no difference but in the lights by which the objects were illuminated, and which in one case was simple, in the other compound; and therefore the distinct vision in the former case, and confused in the latter, could arise from nothing else than from that difference in the lights. Which proves the whole proposition.

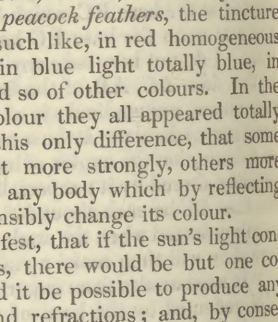
In these three experiments, it is farther very remarkable, that the colour of homogeneous light was never changed by the refraction. And as these colours were not changed by refraction, so neither were they by reflexions. For all white, grey, red, yellow, green, blue, violet bodies, as *paper*, *ashes*, *red lead*, *orpiment*, *indigo*, *bice*, *gold*, *silver*, *copper*, *grass*, *blue flowers*, *violets*, *bubbles of water tinged with various colours*, *peacock feathers*, the tincture of *lignum nephriticum*, and such like, in red homogeneous light appeared totally red, in blue light totally blue, in green light totally green, and so of other colours. In the homogeneous light of any colour they all appeared totally of that same colour; with this only difference, that some of them reflected that light more strongly, others more faintly. I never yet found any body which by reflecting homogeneous light could sensibly change its colour.

From all which it is manifest, that if the sun's light consisted of but one sort of rays, there would be but one colour in the world, nor would it be possible to produce any new colour by reflexions and refractions; and, by consequence, that the variety of colours depends upon the composition of light.

6. *Every homogeneous ray considered apart is refracted, according to one and the same rule; so that its sine of incidence is to its sine of refraction in a given ratio; that is, every differently coloured ray has a different ratio belonging to it.*

Sir Isaac Newton has proved this by experiment; and in other experiments he has determined by what numbers these given ratios are expressed. For instance, if an heterogeneous white ray of the sun emerges out of glass into air; or, which is the same thing, if rays of all colours be supposed to succeed one another in the same line AC, fig. 71. and AD their common sine of incidence in glass be divided into *fifty* equal parts, then EF and GH, the sines of refraction into air, of the least and most refrangible rays, will be 77 and 78 of such parts respectively.

Fig. 71.

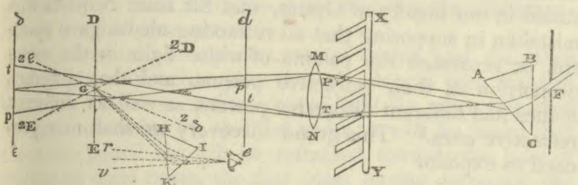


And since every colour has several degrees, the sines of refraction of all the degrees of red will have all intermediate degrees of magnitude from 77 to $77\frac{1}{8}$; of all the degrees of orange from $77\frac{1}{8}$ to $77\frac{1}{5}$; of yellow from $77\frac{1}{5}$ to $77\frac{1}{3}$; of green from $77\frac{1}{3}$ to $77\frac{1}{2}$; of blue from $77\frac{1}{2}$ to $77\frac{2}{3}$; of indigo from $77\frac{2}{3}$ to $77\frac{7}{9}$; and of violet from $77\frac{7}{9}$ to 78.

7. *Whiteness, and all grey colours between white and black, may be compounded of colours; and the whiteness of the sun's light is compounded of all the primary colours, mixed in a due proportion.*

"Let the spectrum or solar image PT, in fig. 72, fall upon the lens MN, above four inches broad, and about six

Fig. 72.



feet distant from the prism ABC, and so figured that it may cause the coloured light which divergeth from the prism to converge and meet again at its focus G, about six or eight feet distant from the lens, and there to fall perpendicularly upon a white paper DE. And if you move this paper to and fro, you will perceive that near the lens, as at *d e*, the whole solar image (suppose at *p t*) will appear upon it intensely coloured after the manner above explained, and that by receding from the lens those colours will perpetually come towards one another, and by mixing more and more, dilute one another continually, until at length the paper come to the focus G, where, by a perfect mixture, they will wholly vanish and be converted into whiteness, the whole light appearing now upon the paper like a little white circle. And afterwards by receding farther from the lens, the rays which before converged will now cross one another in the focus G, and diverge from thence, and thereby make the colours to appear again, but yet in a contrary order; suppose at δ ϵ, where the red *t* is now above which before was below, and the violet *p* is below which before was above.

Let us now stop the paper at the focus G, where the light appears totally white and circular, and let us consider its whiteness. I say, that this is composed of the converging colours. For if any of those colours be intercepted at the lens, the whiteness will cease and degenerate into that colour which arises from the composition of the other colours which are not intercepted. And then if the intercepted colours be let pass and fall upon that compound colour, they mix with it, and by their mixture restore the whiteness. So if the violet, blue, and green be intercepted, the remaining yellow, orange, and red, will compound upon the paper, an orange, and then if the intercepted colours be let pass they will fall upon this compounded orange, and together with it decompound a white. So also if the red and violet be intercepted, the remaining yellow, green, and blue, will compound a green upon the paper, and then the red and violet being let pass, will fall upon this green, and together with it decompound a white. And that in this composition of white the several rays do not suffer any change in their colorific qualities by acting upon one another, but are only mixed, and by a mixture of their colours produce *white*, may farther appear by these arguments.

If the paper be placed beyond the focus G, suppose at δ, and then the *red* colour at the lens be alternately intercepted, and let pass again, the *violet* colour on the paper will not suffer any change thereby, as it ought to do if the several sorts of rays acted upon one another in the focus G where they cross. Neither will the *red* upon the paper be changed by any alternate stopping, and letting pass the *violet* which crosseth it.

And if the paper be placed at the focus G, and the white round image at G be viewed through the prism at HIK, and by the refraction of that prism be translated to the place *r v*, and there appear tinged with various colours, namely, the *violet* at *v* and *red* at *r*, and others between, and then the *red* colour at the lens be often stopped and let pass by turns, the *red* at *r* will accordingly disappear and return as often, but the *violet* at *v* will not thereby suffer any change. And so by stopping and letting pass alternately the *blue* at the lens, the *blue* at *r* will accordingly disappear and return, without any change made in the *red* at *r*. The *red* therefore depends on one sort of rays, and the *blue* on another sort, which in the focus G, where they are commixed, do not act on one another. And there is the same reason of the other colours.

I considered farther, that when the *most* refrangible rays P*p*, and the *least* refrangible ones, T*t*, are by converging inclined to one another, the paper, if held very oblique to those rays in the focus G, might reflect one sort of them more copiously than the other sort, and by that means the reflected light would be tinged in that focus with the colour of the predominant rays, provided those rays severally retained their colours or colorific qualities in the composition of white made by them in that focus. But if they did not retain them in that white, but became all of them severally endued there with a disposition to strike the sense with the perception of white, then they could never lose their whiteness by such reflexions. I inclined therefore the paper to the rays very obliquely, as in the second experiment of this book, that the most refrangible rays might be more copiously reflected than the rest, and the whiteness at length changed successively into blue, indigo, and violet. Then I inclined it the contrary way, that the most refrangible rays might be more copious in the reflected light than the rest, and the whiteness turned successively to yellow, orange, and red.

Lastly, I made an instrument XY, in fashion of a comb, whose teeth were about an inch and an half broad, and the intervals of the teeth about two inches wide. Then by interposing successively the teeth of this instrument near the lens, I intercepted part of the colours by the interposed tooth, whilst the rest of them went on through the interval of the teeth to the paper DE, and there painted a round solar image. But the paper I had first placed so, that the image might appear white as often as the comb was taken away; and then the comb being, as was said, interposed, that whiteness by reason of the intercepted part of the colours at the lens did always change into the colour compounded of those colours which were not intercepted, and that colour was by the motion of the comb perpetually varied, so that in the passing of every tooth over the lens all these colours, red, yellow, green, blue, and purple, did always succeed one another. I caused therefore all the teeth to pass successively over the lens, and when the motion was slow, there appeared a perpetual succession of the colours upon the paper: But if I so much accelerated the motion, that the colours by reason of their quick succession could not be distinguished from one another, the appearance of the single colours ceased. There was no *red*, no *yellow*, no *green*, no *blue*, nor *purple*, to be seen any longer, but from a confusion of them all there arose one uniform *white* colour. Of the light which now by the mixture of all the colours appeared *white*, there was no part *really white*. One part was *red*, another *yellow*, a third *green*, a fourth *blue*, a fifth *purple*, and every part retains its proper colour till it strike the sensorium. If the impressions follow one another slowly, so that they may be severally perceived, there is made a distinct sensation of all the co-

Chromatics. lours, one after another, in a continual succession. But if the impressions follow one another so quickly that they cannot be severally perceived, there ariseth out of them all one common sensation, which is neither of this colour alone nor of that alone, but hath itself indifferently to them all, and this is a sensation of whiteness."

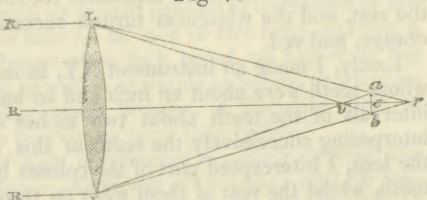
Such is the account which Newton himself has given of the great discovery of the different refrangibility of light.

In examining the prismatic spectrum it is difficult to discover the terminations or boundaries of the different colours. They pass into one another by insensible shades, and if any person were to lay down their apparent limits by the nicest observations, he would find, what has been very recently discovered, that these limits vary with the state of the atmosphere, and with the altitude of the sun. Sir Isaac Newton, however, did make the attempt, and the following are the results which he obtained, we believe with crown or plate glass. We have added the results obtained long afterwards by Dr. Wollaston[1] and Mr. Fraunhofer[2] with flint glass, which shews the difficulty of this class of observations.

	Newton in Crown Glass.	Fraunhofer in Flint Glass.	Wollaston in Flint Glass.
Red	45	56	57·6
Orange	27	27	
Yellow	40	27	
Green	60	46	82·8
Blue	60	48	129·6
Indigo	48	47	
Violet	80	109	90
	360	360	360

Imperfection of refracting telescopes. The influence of these discoveries on the progress of optical science was very remarkable. They led Sir Isaac to discover that the cause of the imperfections of the refracting telescopes was the different refrangibility of the rays of light. If LL, for example, is a lens without spherical aberration, upon which parallel rays R, R, R of white light are incident, then it is obvious that the *violet*, or most refrangible rays will be most refracted in directions Lv, Lv, crossing the axis at *v*, and there giving a *violet* focus of light. In like manner the *red*, or the least refrangible rays, will be refracted in directions Lr, Lr, crossing the axis at *r*, and there giving a *red* focus of light. In like manner all the other rays will have foci of their own colour between *v* and *r*. If we draw the line *ab*, meeting the intersection of the extreme violet rays after their convergence with the extreme red rays before their convergence, it will cut the axis at a point *c*. The line *vr*, is called the *longitudinal aberration of refrangibility*, or the *longitudinal chromatic aberration*, and *ab* is called the *lateral aberration of refrangibility*, or the diameter of the *circle of diffusion*, all the coloured rays being diffused over the circle, of which *ab* is the diameter. The space *v a r b*, is called the sphere of diffusion; and the section of it shewn in the figure may be regarded as a parallelogram, on account of the smallness of the angles *r*Lv, *r*Lv, which are greatly magnified in the figure. Hence it may be easily shewn, that the longitudinal aberration *vr*, is to the lateral aberration *ab*, as the focal distance of the lens is to its radius or half its aperture.

Fig. 73.



In the circle of diffusion *ab*, the light becomes very faint towards *a* and *b*, and very intense in the centre *c*, so that there is formed at *c* a sort of general focus indistinct and coloured. Every part of an object, therefore, will have its image formed in the foci of such a lens similarly indistinct and similarly coloured, and hence we see the reason why refracting telescopes had such great imperfections, that it was necessary to make them of enormous lengths, in order to obtain a sufficient magnifying power.

From these causes, Sir Isaac Newton despaired of the improvement of refracting telescopes, and set himself at an early period of his life to execute reflecting telescopes. His successors, however, Mr. Hall and Mr. Dollond, studied the object of refraction as produced by prisms made of different substances, and found, as we have already fully stated in our history of Optics, that Sir Isaac Newton was mistaken in supposing that all refracting media gave spectra, or separated the colours of white light in the same proportion as their refractive powers, and that different bodies had different dispersive powers, as well as different refractive ones.[3] This grand discovery we shall now proceed to explain.

Sect. II.—*On the different Dispersive Powers of Bodies.*

The term *dispersion* has been employed to denote the separation of the different rays of white light into that divergent beam which constitutes the prismatic spectrum, the differently coloured rays having been dispersed or scattered by their different refrangibility. Sir Isaac Newton believed that all bodies whatever, whether *water*, or *crown*, or *plate*, or *flint glass*, dispersed light in an equal degree, provided the mean refraction, that is, the refraction of the mean or middle ray of the spectrum (the green ray, viz.), of these bodies was equal, or, in other words, that the dispersion, or the angle formed by the extreme red and the extreme violet ray was in different bodies proportional to the mean refraction.

As Sir Isaac Newton submitted to experiment a number of fluid substances, in the form of prisms, it is perhaps one of the most remarkable oversights in the history of science, that he did not think of comparing the length of the spectra which they formed; and it is equally strange that for more than a century he and all his successors should never have thought of forming the spectrum from any other luminous body less in diameter than the sun, or even from any luminous line of small breadth.[4] The consequence of these oversights was, that the most important discoveries relative to light, and to optical instruments, were reserved for another age.

In our *History of Optics*, and in the article Achromatic Glasses, we have given a detailed history of the successive labours of Hall, Dollond, Euler, and others, by which the achromatic telescope was invented and perfected.

If we perform the experiment shewn in fig. 65, with two prisms, the one of *flint*, and the other of *crown* glass, and measure in each the length of the spectrum PT, or rather the angles which the violet and the red rays PA, TA, make with each other, and the angle which the mean *green* ray forms with the direction of the coloured rays SY, this last angle will be the mean refraction of the prism, and the first the angular dispersion. We shall then find, that while in crown glass the quotient obtained by dividing the greater by the lesser angle, or the part of the mean refraction to which the dispersion is equal, will be seventeen hundredths, ($\frac{17}{100}$), while in flint glass it will be thirty hundredths, ($\frac{30}{100}$), this number varying with the nature of the glass.

This result may be exhibited to the eye, by placing behind a prism of crown glass C, another of flint glass F, of such an angle as not to produce any deviation by refraction, the

[1] See page 414, col. 2.
[2] These results are taken from his coloured figure of the spectrum.
[3] See our Article Achromatic Glasses, vol. i. p. 97.
[4] See page 406, col. 1.

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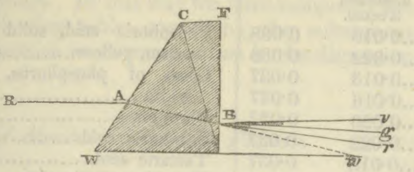
angle of deviation of the green ray produced by the *crown glass* prism C, being compensated by an equal and opposite deviation produced by the *flint glass* prism F; that is, the *green* ray B*g* will emerge parallel to the incident ray RA. When this has been effected it will be seen that there is still a spectrum *rv*, which will colour the edges of any object which is viewed through the prism, and in which will have the same position as if they had been produced by a small flint glass prism placed in the same manner as the flint glass prism F.

Fig. 74.

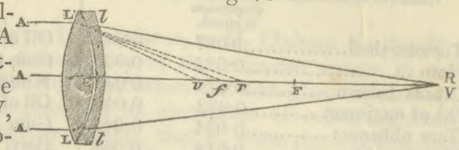


If we now take two prisms, one of *crown*, and the other of *flint* glass, of such angles, that all objects seen through them are colourless, or that a ray of light B*g*, when refracted by them, as in fig. 74, shall be white, it will be found that the white pencil B*w* will be refracted towards the base of the crown glass prism, the flint glass having corrected the colour produced by the crown glass one, but still left a considerable balance of refraction produced by the latter.

Hence it is manifest that the *colours* produced by a convex lens of *crown* glass, as shewn in fig. 73, may be corrected by a concave lens of *flint* glass, while the rays produced by the unbalanced refraction of the convex glass are still converged to a focus. Such a combination of lenses is called an *achromatic object-glass*, and a telescope in which such an object-glass is used is called an *achromatic telescope.*

Nothing is easier than to determine by experiment, when we have obtained good glass for the construction of these lenses, the proper radii to which they should be ground, in order to correct the aberration of colour; but it may be readily shewn, and the reader may easily prove it by the methods already described, that *the aberration of colour produced by a convex lens of crown glass will be corrected by a concave lens of flint glass, provided the focal lengths of the two lenses are proportional to their dispersive power.* Thus, in fig. 75, if LL is a convex lens of crown glass, whose focus for green rays is at *f*, and for violet and red rays at *v* and *r*, and if F is the virtual focus of a concave lens *ll* of flint glass, for the mean green ray, then parallel rays AAA will be refracted to a single focus at RV, where the violet and red rays will be united, provided the focal length of *ll*, viz., EF, is to E*f*, the focal length of LL as 0·068, the dispersive power of *flint* glass, is to 0·033, the dispersive power of *crown* glass.

Fig. 75.



Dispersive powers of bodies.

The dispersive powers of various glasses, and of some fluids, had been measured with considerable care, in reference to the improvement of the telescope, but no attempt was made to investigate it as a branch of physics, exhibiting new and interesting properties of transparent bodies. Dr. Wollaston set the example of beginning this inquiry, and he determined in a very general manner the dispersive qualities of thirty-three substances, which he arranged in the order of their dispersive powers, without giving any numerical estimate of their value. In this state of the subject, Sir David Brewster, by a new method of measuring dispersive powers, which presented considerable facility of observation, made a very extensive series of experiments on the subject, which, in a physical point of view, presented several curious results. In laying the following table of his observations before our readers, we must warn them that they were made, often with the most imperfect specimens of the minerals and fluid substances, from the difficulty of getting any other, and that they were intended only to indicate the general properties of bodies in dispersing light. The want of fixed points in the spectrum, in reference to which the measures could be taken, rendered it necessary to use the extreme points, which varied with the intensity of the light employed, and with the absorbing action of the bodies themselves, when they happened to be coloured or imperfectly transparent. The discovery of the fixed lines, and their use in measuring dispersive powers, introduced by Fraunhofer, has given a new impetus to this subject, and when it is practicable to obtain good prisms of the substance under examination, no other method will or should be adopted.

Table of the Dispersive Powers of various Solid and Fluid Bodies.

Names of substances.	Part of the whole refraction to which the dispersion is equal.	Dispersive power.
Chromate of lead (greatest refraction), estimated at	0·770	0·400
Chromate of lead (greatest refraction), must exceed	0·570	0·296
Realgar, a different kind, melted	0·394	0·267
Chromate of lead (least refraction)	0·388	0·262
Realgar, melted	0·374	0·255
Oil of cassia	0·089	0·139
Sulphur, after fusion	0·149	0·130
Phosphorus	0·156	0·128
Sulphuret of carbon	0·077	0·115
Balsam of Tolu	0·065	0·103
Balsam of Peru	0·058	0·093
Carbonate of lead (greatest refraction)	+0·091	+0·091
Barbadoes aloes	0·058	0·085
Essential oil of bitter almonds	0·048	0·079
Oil of anise seeds	0·044	0·077
Acetate of lead, melted	0·040	0·069
Balsam of styrax	0·039	0·067

Names of the Substances.	Part of the whole refraction to which the dispersion is equal.	Dispersive power.
Guiacum	0·041	0·066
Carbonate of lead (least refraction)	0·056	0·066
Oil of cummin	0·033	0·065
Essential oil of tobacco	0·035	0·064
Gum ammoniac	0·037	0·063
Oil of Barbadoes tar	0·032	0·062
Oil of cloves	0·033	0·062
Green coloured glass	0·037	0·061
Sulphate of lead	0·056	0·060
Deep red glass	0·044	0·060
Oil of sassafras	0·832	0·060
Opal-coloured glass	0·038	0·060
Muriate of antimony (refr. pr. 1·598)	0·036	0·059
Rosin	0·032	0·057
Oil of sweet fennel seeds	0·028	0·055
Oil of spearmint	0·026	0·054
Orange-coloured glass	0·042	0·053
Rock salt	0·029	0·053
Flint glass, Boscovich's, highest		0·0527
Caoutchouc	0·028	0·052
Oil of pimento	0·026	0·052
Flint glass	0·032	0·052

Names of substances.	Part of the whole refraction to which the dispersion is equal.	Dispersive power.
Deep purple glass	0·031	0·051
Oil of angelica	0·025	0·051
Oil of thyme	0·024	0·050
Oil of fenugreek	0·024	0·050
Oil of wormwood	0·022	0·049
Oil of pennyroyal	0·024	0·049
Oil of carraway seeds	0·024	0·049
Oil of dill seeds	0·023	0·049
Oil of bergamot	0.023	0·049
Flint glass	0·029	0·048
Chio turpentine	0·028	0·048
Gum thus	0·028	0·048
Oil of lemon	0·023	0·048
Flint glass	0·028	0·048
Oil of juniper	0·022	0·047
Oil of chamomyle	0·021	0·046
Gum juniper	0·025	0·046
Carbonate of strontites, (greatest refraction)	0·032	0·046
Oil of brick	0·021	0·046
Flint glass, Boscovich's, lowest		0·0457
Nitric acid	0·019	0·045
Oil of lavender	0·021	0·045
Balsam of sulphur	0·023	0·045

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Names of Substances.	Part of the whole refraction to which the dispersion is equal.	Dispersive power.
Tortoise shell	0·027	0·045
Horn	0·025	0·045
Canada balsam	0·024	0·045
Oil of marjoram	0·022	0·045
Gum olibanum	0·024	0·045
Nitrous acid	0·018	0·044
Cajeput oil	0·021	0·044
Oil of hyssop	0·022	0·044
Oil of rhodium	0·022	0·044
Pink-coloured glass	0·025	0·044
Oil of savine	0·021	0·044
Oil of poppy	0·020	0·044
Zircon (greatest refr.)	0·045	0·044
Muriatic acid	0·016	0·043
Gum copal	0·024	0·043
Nut oil	0·022	0·043
Burgundy pitch	0·024	0·043
Oil of turpentine	0·020	0·042
Oil of rosemary	0·020	0·042
Feldspar	0·022	0·042
Glue	0·022	0·041
Balsam of Capivi	0·021	0·041
Amber	0·023	0·041
Oil of nutmeg	0·021	0·041
Stilbite	0·021	0·041
Oil of peppermint	0·019	0·040
Spinelle ruby	0·031	0·040
Calcareous spar (greatest refraction)	0·027	0.040
Oil of rapeseed	0·019	0·040
Bottle glass	0·023	0·040
Tartrate of potash and soda	0·020	0·039
Carbonate of potash (greatest refraction)	0·013	0·039
Gum elemi	0 021	0·039
Sulphate of iron	0·019	0·039
Diamond	0·056	0·038
Oil of olives	0·018	0·038
Gum mastich	0·022	0·038
White of an egg	0·013	0·037
Oil of rhue	0·016	0·037
Gum myrrh	0·020	0·037
Beryl	0·022	0·037
Obsidian	0·018	0·037
Ether	0·012	0·037
Selenite	0·020	0·037
Alum	0·017	0·036
Castor oil	0·018	0·036
Sulphate of copper	0·019	0 036
Crown glass, very green	0·020	0·036
Gum Arabic	0·018	0·036
Sugar, after being melted and cooled	0·020	0·036
Jelly fish, body of, (*medusa æquorea*)	0·013	0·035
Water	0·012	0·035
Aqueous humour of a haddock's eye	0·012	0·035
Vitreous humour of ditto	0 012	0·035
Citric acid	0·019	0·035
Rubellite	0·027	0·035
Leucite	0·018	0·035
Epidote	0·024	0·035
Common glass, Boscovich's, highest		0·0346
Glass of borax	0·018	0·034
Garnet	0·027	0·033
Pyrope	0·026	0·033
Chrysolite	0·022	0·033
Crown glass	0·018	0·033
Common glass, Boscovich's, lowest		0·033
Oil of ambergris	0·012	0·032
Oil of wine	0·012	0·032
Phosphoric acid, solid prism, yellow	0·017	0·032
Glass of phosphorus, white	0·017	0·032
Plate glass	0·017	0·032
Sulphuric acid	0·014	0·031
Tartaric acid	0·016	0·030
Nitre, least refraction	0·009	0·0304
Borax	0·014	0·030
Axinite	0·022	0·030
Alcohol	0·011	0·029
Sulphate of barytes	0·011	0·029
Tourmaline	0·019	0·028
Phosphoric acid, fluid	0·012	0·0283
Carbonate of barytes, least refraction[1]	0·015	0·0285
Malic acid	0·011	0·0282
Carbonate of strontites, least refraction	0·015	0.027
Crown glass, Leith, Robison		0·033
Rock crystal	0·014	0·026
Emerald	0·015	0·026
Borax glass, 1 bor. 2 silex	0·014	0·026
Calcareous spar, least refraction	0·016	0·026
Blue sapphire	0·021	0·026
Bluish topaz from Cairngorm	0·016	0·025
Chrysoberyl	0·019	0·025
Blue topaz, from Aberdeenshire	0·016	0·024
Sulphate of strontites	0·015	0·024
Carbonate of potash,[2] least refraction	0·0088	0·0233
Prussic acid	0·008	0·0227
Fluor spar	0·010	0·022
Cryolite	0·007	0·022

The following measures of the dispersive powers of several varieties of glass were taken by Sir John Herschel, by a method which gave him nearly the extreme rays of the spectrum, namely, by viewing the spectrum through a dark blue glass, which stops the *green*, *yellow*, and most refrangible *red* rays, and therefore allows the extreme rays of the spectrum to be seen,—rays which the eye does not recognise in any of the ordinary lights which are used in optical instruments. If we condense the sun's light, as we have done, in order to render visible rays at the extremities of the spectrum, that have not been recognised, we should obtain dispersive powers still higher than those given by Sir John Herschel. By determining, however, the extremities of the spectrum seen by the ordinary light of the sky, it would be easy to accommodate all measures of dispersive power taken in such a light to those taken in the light used by Sir John Herschel, or in the more condensed and consequently elongated spectrum to which we have referred. In order that the measures in the following tables may be correct, it is necessary that they should all have been taken when the sun had the same altitude, because it is quite certain that the violet part of the spectrum diminishes in length very rapidly as the sun approaches the horizon, and some change also takes place at the red extremity.

Dispersive Powers of different kinds of Glass.

	Part of the whole refraction to which the dispersion is equal.	Dispersive power.
Flint glass,	0·03849	0·06404
Ditto,	0·03705	0·06409
Flint glass,	0·03734	0·06386
Ditto, heavy,	0·03951	0·06555
Ditto,	0·03747	0·06409
Crown glass,	0·02139	0·04063
Ditto, a different kind,	0·02494	0·04704
Plate glass,	0·02616	0·05090

Sir John Herschel justly remarks, that it ought not to excite surprise that the dispersions deduced by this method should considerably exceed all former estimates.[3]

Explanation of the Table.

In the preceding table of dispersive powers we have given two columns of numerical results, the first column containing the part of the whole refraction, or angle of deviation to which the angle of dispersion is equal, and the other the dispersive power itself. The first column is obviously not a measure of the dispersive power, because if the dispersion in that column is $\frac{1}{20}$th part of a low refraction in one body, and the 20th part of a high refraction in another body of great refractive power, the dispersive power of the latter must be smaller than that of the former, in the inverse ratio of the index of refraction of the two bodies minus unity. Hence the numbers in the second column, the dispersive powers, are obtained by dividing the first column by the index of refraction minus one.

Absolute dispersive power.

If we wish to have the intrinsic or *absolute* dispersive powers of bodies, in reference to the action of their ultimate molecules on the theory of emission, and on the supposition, as Sir John Herschel has remarked, in reference to absolute

[1] The dispersive power of the other image is considerably greater than this. See *Edin. Trans.* vol. vii. p. 289.
[2] The least refractive index of this salt, which is not inserted in our table, p. 384, is 1·379.
[3] *Edin. Trans.* vol. ix. p. 458.

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s refractive powers, *of the ultimate atoms of all bodies being equally heavy,* we must divide the numbers in the second column of the preceding table by the specific gravities or densities of the bodies. In this way we have computed the results in the following table, containing the substances principally that exercise an extreme action in the dispersion of light.

Table of Absolute Dispersive Powers.

	Specific gravities used.	Absolute dispersive power.
Sulphate of barytes,	4·48	0·00602
——— strontites,	3·95	0·00607
Carbonate of barytes,	3·70	0·0063
Sapphire,	3·50	0·0066
Chryso-beryl,	3·93	0·00675
Topaz,	3·50	0·00685
Fluor spar,	3·17	0·0069
Cryolite,	2·95	0·0074
Diamond,	3·50	0·0109
Plate glass,	2·76	0·0112
Rock salt,	2·143	0·0250
Water,	1·00	0·035
Amber,	1·04	0·0400
Oil of olives,	0·913	0·0415
Oil of turpentine,	0·87	0·0483
Sulphur, fused,	2·00	0·065
Realgar,	3·50	0·0728
Phosphorus,	1·75	0·0731
Oil of anise seeds,	0·987	0·078
Bi-sulphuret of carbon,	1·27	0·081
Oil of cassia,	1.044	0·131

These results present us with several views of considerble interest. The salts of barytes have, in reference to heir density, the least dispersive power of all bodies, and he next in order are the gems, including even diamond, which occupies so different a place in our table of absolute efractive powers. The inflammable bodies, with the exeption of diamond, stand at the head of the table, *oil of assia* having by far the greater absolute dispersive power f any body yet examined. That this is owing to the hyrogen which it contains is very probable, and has almost een proved by an experiment by Sir John Herschel, who eprived a portion of this oil of most of its hydrogen by aking a stream of chlorine pass through it till it refused act any farther. By this means he converted the oil nto a viscous mass, the dispersive power of which was diinished one-half, while its refractive power had hardly uffered any change. This result leads us to conclude that *ydrogen* has the greatest intrinsic dispersive power of all odies. *Fluorine* seems to be the element which has nearly e lowest refractive power.

One of the most interesting results exhibited in the geeral Table of dispersive powers, relates to the dispersive owers of doubly refracting substances. Dr. Wollaston d measured the dispersive power of the ordinary ray in lcareous spar, so far at least as to ascertain that it stood ove water, and plate and crown-glass. Sir David Brewshad been led to measure the dispersion of the extraordiry ray, and found it to be much lower than that of water. was hence induced to examine the dispersive powers of er doubly refracting crystals, and was thus led to the ret which we have stated.[1] Similar results have been re recently obtained by M. Rudberg and Mr. Cooper, hout knowing that the subject had been previously invested.

SECT. III.—*On the Irrationality of the Coloured Spaces in the Spectrum, and the existence of a secondary Spectrum.*

We are indebted, we believe, to M. Clairaut for the discovery of the irrationality of the coloured spaces in the spectrum. He found that when the flint-glass of an achromatic object glass had its aberration of colour as completely corrected as possible, that is, when the extreme red and violet rays were accurately united in the same focus, still there remained a portion of incorrected colour, which was of a purple or claret colour on one side of the focus, and of a green colour on the other. If prisms had been used in place of lenses, and the sun's light transmitted through them in the usual manner, there would have been a small recidual spectrum, or *secondary spectrum* as it has been called, consisting of purple and green light. The Abbé Boscovich afterwards observed the same fact, but considered it so extraordinary that he suspected some latent cause of error, and submitted his experiments to the most rigid scrutiny. He at last admitted the irrationality of the coloured spaces in the spectrum as a demonstrated truth, and has shewn how three of the colours of the spectrum may be corrected or united in the same focus in achromatic telescopes. The late Professor Robison obtained similar results, and gave the name of *outstanding* colours to those which were not united, and form the secondary spectrum.

Secondary spectrum.
Clairaut.
Boscovich.
Robison.

This subject was more fully investigated by Dr. Blair, in his interesting paper on the unequal refrangibility of light,[2] and he has shewn that the proportions of the coloured spaces vary with the substance of the opposing prisms, so that a complete correction of colour cannot possibly be effected by two media of different dispersive powers. Hence Dr. Blair was led to examine the nature of the dispersive action of different media, and by the most ingenious devices succeeded in producing fluid object-glasses in which the *aberration of colour was completely corrected.* The telescopes which he made on this principle were so extraordinary, that Professor Robison assures us that one of them, FIFTEEN inches in focal length, *equalled in all respects, if it did not surpass, the best of Dollond's* FORTY-TWO inches long.

Blair.

Under these circumstances, the scientific world was surprised at the following statement published by Dr. Wollaston in the *Phil. Trans.* for 1803. "Since the proportions of these colours *have been* supposed by Dr. Blair to vary according to the medium by which they are produced, I have compared with this appearance, the coloured images caused by prismatic vessels containing substances supposed by him to differ most in this respect, such as strong but colourless nitric acid, rectified oil of turpentine, very pale oil of sassafras, Canada balsam, also nearly colourless. With each of these, I have found the same arrangement of these four colours, and in similar positions of the prisms, as nearly as I could judge, the same proportions of them." Dr. Blair was surprised that Dr. Wollaston should have used such a coarse method of determining a point that required delicate observations, especially with the substances above mentioned; and he remarked to the writer of this article, that if Dr. Wollaston would only make use of lenses, he would see his mistake after a single observation.

Wollaston.

There is no doubt, however, that the secondary spectrum can be made very visible by prisms, and if we use a prism of oil of cassia to correct the colour produced by another of sulphuric acid, we shall have a striking ocular proof of the existence of a large secondary spectrum.

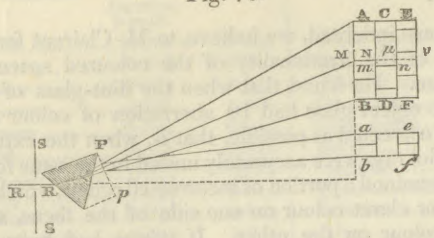
The phenomena of a secondary spectrum will be understood from fig. 76, where RR is a ray passing through an aperture in the window-shutter SS, and refracted by a prism P in the direction PM, so as to form the spectrum AB on the

[1] See *Phil. Trans.* 1813, p. 107, where this result was first published.

[2] *Edin. Trans.* vol. iii. p. 3.

wall, PA being the extreme violet ray, PM the mean ray, and PB the extreme red. The spectrum will consist of four

Fig. 76.



palpable colours, *red, green, blue, and violet*, and if the prism is one of *crown-glass*, the mean ray PMN which bisects the spectrum will be at the boundary of the blue and green spaces. If we were to take a prism of flint-glass with a much less refracting angle, and form a spectrum CD of the same length as AB, and at the same distance from the prism, the line *mn* which marks the boundary of the blue and green spaces will no longer be the mean ray of the spectrum, but will be decidedly nearer the *red* extremity D. The least refrangible half of the spectrum has therefore been more contracted, and the most refrangible half more expanded than in the crown-glass spectrum. If we now take a prism of sulphate of barytes or fluor spar, capable of forming a third spectrum EF of the same length as the other two, the boundary of the blue and green spaces will now be at $\mu\nu$ nearer the violet than the red extremity of the spectrum, and the least refrangible half of this spectrum will be more *expanded*, and the most refrangible half more *contracted*, than in the crown-glass spectrum.

"If a spectrum," says Sir David Brewster, [1] "formed by flint-glass, had its coloured spaces exactly of the same dimensions with those of an equal spectrum formed by crown-glass, any object such as a window-bar lying parallel to the common section of the refracting planes of the two prisms should appear perfectly colourless when seen through the combined prisms. But if the coloured spaces in the two spectra are not proportional, as shewn in fig. 76, but are *irrational*, then the window-bar cannot be wholly free from colour, for though the extreme red and violet rays of both the spectra are united, yet the intermediate colours are not rendered coincident. In the spectrum AB, formed by the crown-glass, the first green ray MN, which is here the mean ray, is obviously more refracted than the first green ray *mn*, in the spectrum CD formed by the flint-glass, and therefore the flint-glass will not be able to refract the green ray, so as to unite it with the red and violet. Hence the green ray will, as it were, be left behind, while the red and violet rays are rendered coincident. Thus, in fig. 76, if a prism *p* of flint glass is placed behind a crown-glass prism P, so as exactly to correct its dispersion, the spectrum AB will be reduced to a secondary spectrum *ab*, the upper half of which is *green*, which is left behind, and the lower half is of a *claret* colour, formed by the union of the red and violet rays. If the bar of a window had been examined through the combined prisms P, *p*, the upper side of it would have been tinged with green, and the lower side of it with a claret-coloured fringe.

By comparing, in a similar manner, the spectrum EF, formed by fluor spar, with the spectrum AB, formed by crown glass, it will be found, that the fluor spar having a greater action than the crown glass upon the green ray, will carry it beyond the place of the united red and violet, and will form a secondary spectrum *ef*, the lower half of which is *green*, and the upper half of a *claret* colour, arising from the union of the red and violet light. If the bar of a window were viewed through the combined prisms of crown-glass and rock crystal, it would be tinged with green on its lower side, and with a claret-coloured fringe on its upper side.

When a horizontal window-bar, therefore, is seen through any two prisms which correct each other's dispersion, without uniting all the colours, the green fringe will always be on the same side of the bar with the vertex of the prism which has the least action upon the green light, or which *contracts* the red and green rays, and *expands* the blue and violet ones; that is, if the vertex of the flint glass prism is pointing downwards, the uncorrected green fringe will be on the lower side of the bar. By observing, therefore, the position of the green fringe, we can immediately ascertain which of the two prisms has the greatest action upon the green light.

These theoretical deductions from the assumed inequality of the coloured spaces are completely established by observation.

The following Table contains the result of a numerous series of observations made by Sir David Brewster on the secondary spectra of different bodies, the substances being arranged inversely according to their action upon green light. The bodies at the top of the Table form spectra, in which the red and green spaces are most contracted, and the blue and violet ones most expanded. The relative position of some of the substances, particularly the essential oils, is quite empirical; but by a reference to the original experiments, it will be seen whether or not the relative action of any two bodies has been determined.

Table of Transparent Bodies, arranged inversely according to their Action upon Green Light.

1 OIL OF CASSIA.
Sulphur.
Sulphuret of Carbon.
Balsam of Tolu.
5 Carbonate of lead.
Essential oil of bitter almonds.
Oil of anise seeds.
Oil of cummin.
Oil of sassafras.
10 Oil of amber.
Acetate of lead melted.
Opal-coloured glass.
Orange-coloured glass.
Red-coloured glass.
15 Oil of sweet fennel seeds.
Oil of cloves.
Muriate of antimony.
Oil of lavender.
Canada balsam.
20 Oil of Turpentine.
Oil of sage.
Oil of pennyroyal.
Oil of poppy.
Oil of hyssop.
25 Oil of spearmint.
Amber.
Oil of lemon.
Oil of caraway-seeds
Oil of nutmegs.
30 Oil of thyme.
Oil of peppermint.
Oil of bergamot.
Oil of marjoram.
Oil of wormwood.
35 Oil of dill seeds.
Oil of chamomyle.
Castor-oil.
Gum copal.
Rosin.
40 Diamond.
Nitrate of potash.
Oil of beech-nut.
Oil of rue.
Oil of Savine.
45 Nut-oil.
Balsam of capivi.
Oil of fenugreek.
Oil of rosemary.
Oil of rhodium.
50 FLINT GLASS.
Zircon.
Oil of olives.
Oil of rape seed.
Oil of spermaceti.
55 Oil of Juniper.
Oil of ambergris.
Calcareous spar.
Rock-salt.
Gum juniper.
60 Tartrate of potash and soda.
Oil of almonds.
CROWN GLASS.
Gum-Arabic.
Alcohol.
65 Ether.
Borax, glass of.
Borax.
Tourmaline.
Leucite.
70 Selenite.
Beryl.
Topaz blue.
Fluor spar.
Citric Acid.
75 Malic Acid.
Ascetic acid.
Nitrous acid.
Muriatic acid.
Prussic acid.
80 Nitric acid.
Rock crystal.
White of an egg.
Ice.
WATER.
85 Super-sulphuretted hydrogen.
Phosphorous acid.
Sulphurous acid.
Phosphoric acid.
89 SULPHURIC ACID.

[1] *Treatise on New Philosophical Instruments*, 1813, p. 316.

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Dr. Blair's aplanatic telescopes.

Finding it impossible to obtain any highly dispersing medium which should refract the rays of the spectrum in the same manner as crown glass, Dr. Blair thought of employing this very imperfection in obtaining a perfect correction of colour. As the green rays removed the outstanding ones, or were not united in the same focus with the red and violet, he considered that if an achromatic *concave* lens should refract the outstanding green more strongly than the united red and violet, while an achromatic *convex* lens should also refract the outstanding green more strongly than the united red and violet, then two such achromatic lenses combined might unite the outstanding green with the red and violet, and thus effect a perfect union of all the colours. Hence he took the combination shewn in fig. 77, for a concave lens, composed of a concave lens *ab*, of crown glass, and a convex lens *cd* of a fluid which had its dispersive power of such a character as to unite the *red* and *violet* rays as stated in the figures, and leave the green outstanding and *most refracted.* He then made an achromatic *convex* lens, fig. 78, composed of a convex lens *hg* of an essential oil, the same as that in *cbd*, which disperses the rays in a lesser degree, and of a concave lens *fehg* of an essential oil which disperses the rays in a much greater degree. This compound lens has its convexity such as to unite at a convenient distance, rays which diverge from the violet focus of the compound concave lens shewn in fig. 77, and therefore its focal length must be much shorter than the other, like the flint lens in a common achromatic. But though the focal lengths of the two compound lenses are thus different, yet, the distance or deviation of the outstanding green, from the united red and violet, is equal in both.

Fig. 77.

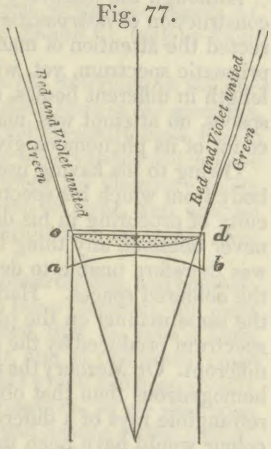
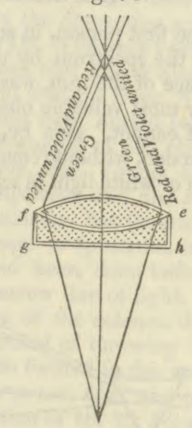
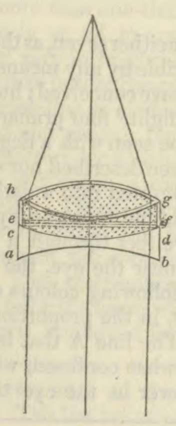


Fig. 78.



When these two compound lenses are placed in contact, as shewn in fig. 79, it is manifest that the equal and opposite deviations of the green ray will balance each other, and that this ray will therefore be united with the red and violet, and thus form a pencil exempt from secondary colours. The plates of glass shewn by dotted lines at *ef*, *cd*, though necessary when the two compound lenses are separate, as in fig. 77, 79, are of course removed, since the two fluids which they separate, as fig. 78, are the same. Hence the compound object-glass, consists of a concave lens of crown glass *ab*, of a meniscus *ef*, of a fluid, and a convex glass of another fluid, enclosed in two glasses like watch-glasses. Dr. Blair found it best in practice to make all the glasses concave meniscuses in place of having all the concavity in one lens *ab*.

Fig. 79.



In continuing his experiments, Dr. Blair happened to try the muriatic acid mixed with a metallic solution; he found it best to make his compound convex lens, as shewn in fig. 78, of crown glass, and that fluid which enabled him to correct the colour of the compound concave in fig. 77, and likewise to correct the aberration of figure by a concave which lengthens only by one-third the focal distance of the convex.

When he was trying a compound concave formed only of crown glass and muriatic acid, he observed that this fluid produced an inverted secondary spectrum, and gave a primary spectrum, in which the green rays were among the most refrangible, and hence he was conducted to the idea of forming a compound lens consisting merely of a single concave lens of muriatic acid placed between a plano-convex and a meniscus of crown glass. In this lens, which he actually constructed and used, he observes *that the rays of different colours were bent from their rectilineal course with the same equality and regularity as in reflexion.*[1]

Fig. 80.

In such telescopes, Dr. Blair found that when the focal length of the object-glass was *nine inches,* the aperture might be increased as far as *three* inches; and in order to distinguish such instruments where the aberration is removed from *achromatic* ones in which it is only partially removed, he proposes the use of the term *aplanatic.*[2]

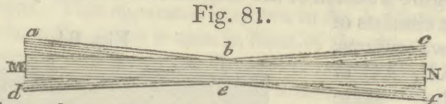
Sect. IV.—*On the tertiary spectrum, and the method of correcting the aberration of colour by prisms and lenses of the same kind of glass.*

Tertiary spectrum.

The existence of the *tertiary* spectrum was discovered experimentally by Sir David Brewster, who deduced it also from the constant ratio of the sines. It is produced when the dispersion of a prism of any substance is corrected by another prism of the same substance with a different refracting angle. An irrationality takes place in the coloured spaces, which prevents the correction of colour from being complete. The residuary spectrum was therefore called the *tertiary* spectrum merely to distinguish it from the *secondary* one, which is produced by the specific quality in the refracting media, which act in opposition to each other.

In examining the phenomena of this new spectrum, Sir David Brewster was led to a very paradoxical method of exhibiting it.

Fig. 81.



Having formed a prism of oil of cassia, with a large refracting angle, and viewing through it the broadest horizontal bar of a window, so that the edges of the bar were free of all colours, he inclined the prism so as to make the bar exhibit at its edges the prismatic colours, as shewn in fig. 81, where the edges *b*M and *e*N had spectra *ba*M, *ef*N, consisting of the usual *red* and *yellow* rays, while the edges *e*M, *b*N had spectra *ed*M, *bc*N composed of the usual blue and violet rays. These spectra increased from *b* and *e* towards M and N, and at the nodes *b*, *e*, where the spectra would have vanished, had each face of the prism received the rays symmetrically, the *tertiary spectrum* was clearly displayed in the form of a *green* and *purple* fringe.

In order to produce refraction without colour by two prisms of the same kind of glass, they may be combined, as in fig. 82, where a ray of light R incident on the first prism AB is refracted to the axis MF at F. The prism AB has a smaller refracting angle than CD, and is placed in an oblique position, so that its dispersion is increased in a greater ratio

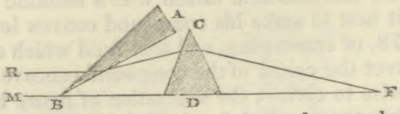
[1] *Edin. Trans.* vol. iii. p. 53.

[2] *Id. Id.*

Chromatics.

than its refraction, for the purpose of correcting the dispersion of CD without balancing its refraction; the prism CD having a position in which its refraction and dispersion are a minimum.

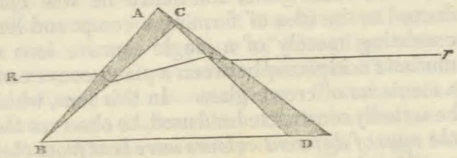
Fig. 82.



The ray R will therefore converge colourless, and meet the axis at F.

If the prisms have the same refracting angle, and are placed in the position shewn in fig. 83, the ray R will emerge colourless in the direction *r*. This combination of prisms, as well as that in fig. 82, has the property of expanding all objects viewed through them, in a vertical plane passing through their sections BACD, that is, of *magnifying them in one plane*. Hence, if we place another similar pair of prisms horizontally, this pair also will magnify objects in a horizontal plane, and by combining these two pair of prisms, we obtain an instrument which will expand or magnify objects in all directions.

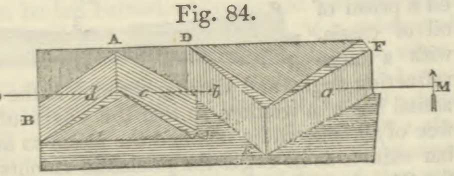
Fig. 83.



This instrument was first constructed by Sir David Brewster in 1812, under the name of a *teinoscope*, for altering the proportions of objects in plans and drawings, by expanding them differently in rectangular directions;[1] and there is reason to think that Dr. Blair was early acquainted with this method of magnifying objects by prisms. Mr. Archibald Blair a few years ago put into Sir David Brewster's hands an instrument of this kind, composed of four prisms which had been executed by his father, but the date of its construction he had no means of discovering. There cannot, therefore, be the shadow of a doubt that both the principles and the invention of an instrument for magnifying objects by means of prisms, were known and published in Scotland long before the celebrated M. Amici of Modena brought forward a contrivance of the same kind. That M. Amici's invention was an independent one will not be questioned.

As we conceive that a telescope of this kind may have many useful applications, we have given in the annexed figure a sketch of the instrument as actually fitted up for use. It consists of two prisms, AB, AC of the same kind of glass, and having a small refracting angle.

Fig. 84.



Their common line of junction at A is horizontal, and their planes of refraction vertical. Other two similar prisms DE, EF, are placed transversely, their common line of junction at E being vertical, and their planes of refraction horizontal. An object M, therefore, seen through the prisms in the direction OM, by an eye placed at O, will be magnified three, four, or five times, or more according to the inclination and angles of the prisms. It is expanded or stretched out in a horizontal plane by the two first prisms ED, EF, and then expanded and stretched out in a vertical plane by the other two prisms, AB, CD.

If we use homogeneous light, we may construct the instrument with only two prisms, as there is no necessity for correcting the colour with a second prism. For solar observations, the two prisms will constitute a telescope, a darkening glass being used as in other instruments. It will be thus equally useful for viewing the lines in the spectrum, where homogeneous light is necessarily used; and by placing two, three, or four instruments in the same tube, we may obtain any magnifying power we desire. The writer of this article is at present occupied with the construction of one of these instruments with rock salt prisms. The length of the instrument which we have drawn is only *two inches and three quarters.*

Prism Spec...

Sect. V.—*On the Optical Phenomena of the Spectrum.*

Phenomena of spectra.

Although the discovery of the principle, and the actual construction of *achromatic* and *aplanatic* telescopes had directed the attention of many observers to the nature of the prismatic spectrum, yet, with the exception of its varying length in different bodies, and the continuity of its coloured spaces, no attempt was made to question the general account of its phenomena given by Sir Isaac Newton.

Owing to his having used the diameter of the sun as the body from which his spectrum was formed, and to the difficulty of procuring in his day good prisms of glass, Sir Isaac never obtained any thing like pure homogeneous light, and was therefore unable to determine the exact boundaries of the coloured spaces. Had the spectrum been observed in the same manner on the planet Mercury and on Saturn, the spectrum produced by the same prism would have been very different. On Mercury the rays would have been less pure and homogeneous than that observed on our earth, and the mean refrangible rays of a different colour; while on Saturn the colour would have been more pure and homogeneous.

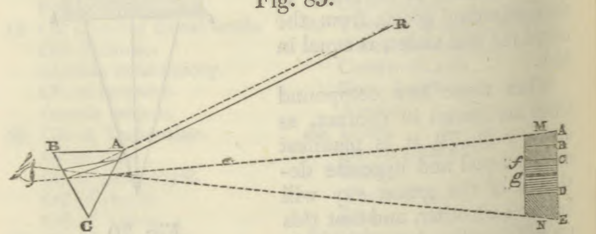
1. *Discoveries of Dr. Wollaston.*

Discoveries of Dr. Wollaston.

The first person, in so far as we know, who proposed to form the spectrum by using *a very narrow pencil of light* in place of the sun, was Dr. Wollaston, to whom we owe many most valuable observations on the subject.

"I cannot," says he, "conclude these observations on dispersion, without remarking, that the colours into which a beam of white light is separable by refraction, appears to me

Fig. 85.



to be neither seven, as they usually are seen in the rainbow, nor reducible by any means (that I can find) to three, as some persons have conceived; but that by employing a very narrow pencil of light,[2] four primary divisions of the prismatic spectrum may be seen with a degree of distinctness, that I believe has not been described nor observed before. If a beam of daylight be admitted into a dark room by a crevice $\frac{1}{20}$ of an inch broad, and received by the eye at the distance of ten or twelve feet through a prism of flint glass, *free from veins*, held near the eye, the beam is seen to be separated into the four following colours only, *red*, *yellowish green*, *blue*, and *violet*, in the proportions represented in the figure.

"The line A that bounds the *red* side of the spectrum is somewhat confused, which seems in part owing to the want of power in the eye to converge red light. The line B,

[1] *Edinburgh Phil. Journal*, vol. vi. p. 334, April 1822.

[2] See p. 406.

Prismatic Spectrum.

between red and green in a certain position of the prism, is perfectly distinct; so also are D, and E, the two limits of violet. But C, the limit of green and blue, is not so clearly marked as the rest; and there are also, on each side of this limit, other distinct dark lines, *f* and *g*, either of which, in an imperfect experiment, might be mistaken for the boundary of these colours.

"The position of the prism in which the colours are most clearly divided, is when the incident light makes about equal angles with two of its sides. I then found that the spaces AB,BC,CD,DE, occupied by them, were nearly as the numbers 16, 23, 36, 25." Dr. Wollaston adds, that when the inclination of the prism is altered so as to increase the dispersion of the colours, the proportions of them to each other are then also changed, so that the spaces AC and CE, instead of being as before 39 and 61, may be found altered as far as 42 and 58.

The lines which Dr. Wollaston has described in the preceding observations, are called the *fixed lines in the spectrum*, and may be considered, as we shall presently have reason to see, as one of the most valuable observations which have been made on this subject. He owed the discovery solely to his having used a *narrower* line of light, and had he employed a still narrower and brighter line, he would have seen many more lines.

In considering Dr Wollaston's observations, and comparing the results with those of Sir Isaac Newton, we must carefully attend to the circumstance, that he used *a beam of day-light*, not one of sun-light, and as this beam emanated from the blue sky, and was light which had been greatly modified by the action of the atmosphere, as we shall soon show, his estimate of the number and nature of the coloured spaces, does not in the least affect or invalidate the observations of preceding authors. The sun's light used by Newton had lost many of its rays, by the absorptive action of the atmosphere, before it fell upon Dr. Wollaston's prism. In consequence of taking it for granted that Dr. Wollaston was analysing the same kind of light that Sir Iasac Newton analysed, both he and Dr Young were misled in the interpretation of the phenomena. Speaking of the observations of Newton and his followers, Dr. Young says, "The observations were however imperfect, and the analogy was wholly imaginary. Dr Wollaston has determined the division of the coloured image or spectrum, in a much more accurate manner than had been done before: by looking through a prism, at a narrow line of light, he produces a more effectual separation of the colours, than can be obtained by the common method of throwing the sun's image on a wall. The spectrum formed in this manner consists of four colours only, *red*, *green*, *blue*, and *violet*, which occupy spaces in the proportion of 16, 23, 36, and 25, respectively, making together 100 for the whole length; the red being nearly one-sixth, the green and the violet each about one-fourth, and the blue more than one-third of the length. The colours differ scarcely at all in quality within their respective limits, but they vary in brightness; the greatest intensity of light being in that part of the green which is nearest to the red. A narrow line of *yellow* is generally visible at the limit of the red and green; but its breadth scarcely exceeds that of the aperture by which the light is admitted, and Dr. Wollaston attributes it to the mixture of the *red* with the *green* light. There are also several dark lines crossing the spectrum within the blue portion and in its neighbourhood, in which the continuity of the light seems to be interrupted. This distribution of the spectrum Dr. Wollaston has found to be the same whatever refracting substance may have been employed for its formation; and he attributes the difference, which has sometimes been observed in the proportion, to accidental variations of the obliquity of the rays." Hence Dr. Young was led to suppose that the *yellow* line was the accidental union of the extremity of the *red* and *green* spaces,—to regard *yellow* as a mixture of *red* and *green* light, and to suppose that the *green space* consisted only of homogeneous green without any mixture of yellow. "In consequence," says he, "of Dr. Wollaston's *correction* of the description of the prismatic spectrum compared with these observations, it became necessary to modify the supposition that I advanced in the last Bakerian lecture respecting the proportions of the sympathetic fibres of the retina; *substituting* RED, GREEN, and VIOLET, for RED, YELLOW, and BLUE." In this manner the *yellow* space was struck out of the spectrum on the authority of Dr. Wollaston's observations!

2. *Discoveries of Fraunhofer.*

Discoveries of Fraunhofer.

Without knowing any thing of the discovery of fixed lines in the sky light by Dr. Wollaston, M. Fraunhofer, a celebrated practical optician at Benedictbaiern near Munich, made a series of the most beautiful discoveries respecting the spectrum, which he published in 1814 and 1815. By making use of prisms of uniform density, and entirely free of veins, and by excluding all extraneous light, and stopping the rays which formed the coloured spaces which he was not examining, he made the important discovery that the *solar* spectrum was covered with a great number of black lines of different thicknesses parallel to each other, and perpendicular to the length of the spectrum. Lines in the spectrum.

All kinds of prisms, fluid or solid, provided they were good, exhibited the same lines, and Fraunhofer found, that these lines had a fixed position in the spectrum, and that they varied with the length of the spectrum, the distance between any two affording a precise measure of the action of the prism on the rays in which these two lines were placed. These lines are darker than the rest of the spectrum, and some of them appear entirely black. The largest lines could scarcely be seen if the aperture exceeded *a minute*, and the finest lines also disappeared entirely when the aperture was 40″. The aperture used by Fraunhofer was 36″ high, and 15″ wide, that is, at a distance of 24 feet from the aperture. It was nearly one-fiftieth of an inch wide, and 2.88 inches high. The prism was made of flint-glass, had a refracting angle of nearly 60°, and was placed before the object-glass of the telescope, so that the angles of incidence and emergence were equal, or the angle of refraction a *minimum*. This apparatus is shewn in fig. 1, Plate CCCLXXXI, where the prism is seen in front of the object-glass of the telescope of a repeating theodolite resting on a horizontal plane with a steel axis round which it moves. The box on which the axis turns is firmly united with the telescope. Plate CCCLXXXI. Fig. 1.

When the prism was turned round, so as to increase the angle of incidence, the lines disappeared, and the same took place when the angle of incidence was diminished. But the lines reappeared at a greater incidence by shortening, and at a smaller incidence by lengthening the telescope.

The *solar prismatic spectrum*, as seen by Fraunhofer, is represented in fig. 2 of Plate CCCLXXXI which has been abridged, and many of the lines necessarily omitted, Fraunhofer himself, having been obliged to leave them out of his map. At the line A the *red* space nearly terminates, and the violet space at I; but when the light of an illuminated cloud fell upon the aperture in the prism, the spectrum appeared to terminate on one side at B, and on the other between G Fig. 2.

Dr. Young has given in his Elements of Nat. Phil. vol. 1. p. 786, plate 29, a small coloured drawing of the spectrum as seen by Dr. Wollaston and himself, with the *yellow* line. This line has no existence in the true solar spectrum.
Nat. Phil. vol. ii. p. 637.

Prismatic Spectrum.

and H. At A there is a distinct and well defined line, the boundary of the red space being a little beyond it. "At *a* there is a mass of lines, forming together a band darker than the adjacent parts. The line at B is very distinct, and of a considerable thickness. From B to C may be reckoned nine very delicate and well defined lines. The line at C is broad, and black like D. Between C and D are found nearly 30 very fine lines, which, however, with the exception of two, cannot be perceived but with a high magnifying power, and with prisms of great dispersion; they are besides well defined. The same is the case with the lines between B and C. The line D consists of two strong lines separated by a bright one. Between D and E we recognise about 84 lines of different sizes. That at E consists of several lines, of which the middle one is the strongest. From E to *b* there are nearly 24 lines. At *b* there are three very strong ones, two of which are separated by a fine and clear line. They are among the strongest in the spectrum. The space *b*F contains nearly 52 lines, of which F is very strong. Between F and G there are about 185 lines of different sizes. At G many lines are accumulated, several of which are remarkable for their size. From G to H there are nearly 190 different lines. The two bands at H are of a very singular nature. They are both nearly equal, and are formed of several lines, in the middle of which there is one very strong and deep. From H to I they likewise occur in great numbers, Hence it follows that, in the space BH, there are 574 lines. The relative distances of the strongest lines were measured with the theodolite, and placed in the figure from observation. The faintest lines only were inserted from estimation by the eye." The lines in the solar spectrum which we have thus minutely described after Fraunhofer, are not seen in the spectra formed by any white flame, or white light, whether it is generated by ordinary combustion, or produced by the application of intense heat to a solid body. In the flame of a lamp, however, Fraunhofer discovered that there is a double yellow line occupying *exactly* the same place as the double line D, the two black lines of D corresponding with the two luminous ones of the double yellow line in lamp light. Hence it follows that ordinary *white* light, produced in the manner already mentioned, has 590 rays of a definite refrangibility which do not exist in solar light, and hence the black lines have been called *defective rays* or *lines*.

"Various experiments," says Fraunhofer, "and changes to which I have submitted these lines, convince me that they have their origin in the nature of the light of the sun, and that they cannot be attributed to illusive observations, or any other secondary cause."

By means of the apparatus shewn in fig. 1, Plate CCCLXXXI, Fraunhofer determined in a very accurate manner the distances between the principal fixed lines[1] B, C, D, E, F, G, H, taking those which divided the spectrum most conveniently. The line *b* for example, would have been better than E for its magnitude and distinctness, but it does not divide the space DF so equally. He repeated these observations with different kinds of flint and crown glass of several fluids, and obtained the results given in the following table.

Table, shewing the Distances of the Principal Fixed Lines in the Spectrum, in various Media, according to Fraunhofer.

Different combinations of Refracting Media.	Temperat. Fahren.	Specific gravity.	Angle of the prism.	Angle of deviation.	BC	CD	DE	EF	FG	GH
	°		° ′ ″	° ′ ″	′ ″	′ ″	′ ″	′ ″	° ′ ″	° ′ ″
Flint glass, No. 13,....	65¾	3·723	26 24 30	17 27 8	3 16	9 4·2	11 50	10 33·9	20 23·9	18 18
Crown glass, No. 9,...	63½	2·535	39 20 35	22 38 19	2 44·5	7 23·5	9 14	8 14	15 10	13 18
Water,...................	65¾	1·000	58 5 40	22 36 40	3 24	8 10	9 58	8 38	15 16	12 41·9
Water,...................	65¼	1·000	58 5 40	22 36 40	3 12·4	8 10·6	9 57·5	8 30·5	15 15·6	12 46·2
Sol. of potash in water,	52¼	1·416	58 5 40	27 45 56	4 2	10 26	12 54	11 12	20 36	17 24
Oil of turpentine,......		0·885	58 5 40	33 20 12	4 56	13 52	18 46·1	16 14	31 8	27 28
Flint glass, No. 3,......		3·512	27 41 35	17 35 16·6	3 8	8 22	10 46	9 50	19 10	17 10
Flint glass, No. 30,....		3·695	21 42 15	14 3 9	2 35·6	6 56·8	9 12·6	8 19	16 15·6	14 32·2
Crown glass, No. 13,...		2·535	43 27 36	25 26 35·4	3 5	8 14·4	10 28·2	9 10	17 14·8	14 48·4
Crown glass,...........		2·756	42 56 40	26 39 13	3 32·8	9 37·6	12 29·8	11 1·6	20 53·6	18 17·4
Flint glass, No. 23,....		3·724	60 15 42	49 55 13·2	11 12·6	31 14·8	41 21·4	38 14·8	1 14 45·2	1 8 3·6
Flint glass, No. 23,....		3·724	45 23 14	32 45 12·2	6 26	17 47·8	23 31·8	21 23·8	41 33·4	37 28·8

These valuable data were deduced from measures taken *six* times for each substance; but as the theodolite was only twenty-four feet distant from the window of his dark room, it became necessary to apply a correction to the angle of deviation μ, arising from the distance 4·25 inches of the centre of the prism from the axis of the theodolite. This correction would have been very great for twenty-four feet, and therefore Fraunhofer, to avoid the uncertainty which

[1] The reader will be desirous of knowing, which of these principal lines were discovered by Dr. Wollaston. The following attempt to do this is given by Sir David Brewster in his Report on Optics, published in the Proceedings of the British Association, vol. i. p. 320, note 2. In the spectrum formed by a narrow beam of day-light, Dr. Wollaston had previously to the year 1802, discovered *seven* lines, which he has designated by the letters A, B, *f*, C, *g*, D, E, the first line A being, according to his observations, the extreme boundary of the red rays, and the last line E the extreme boundary of the *violet* rays. The correspondence of these lines with those of Fraunhofer, I have with some difficulty ascertained to be as follows—

A, B, *f*, C, *g*, D, E Wollaston.
B, D, *b*, F, G, H. Fraunhofer.

There is no single line in Fraunhofer's drawing in the spectrum, (nor is there any in the real spectrum) coincident with the line C of Wollaston; and indeed he himself describes it as not being "so clearly marked as the rest." I have found, however, that this line C corresponds to a number of lines half way between *b* and F, which, owing to the absorption of the atmosphere, are particularly visible in the light of the sky near the horizon. In order to have seen the lines B and H of Fraunhofer, especially the last, Dr. Wollaston's "beam of day-light" must have come from a part of the sky very near the sun's disc.

arises from a great correction, determined the angle μ for the yellow ray of the light of a lamp which has the same refrangibility as D. When the lamp was placed at the distance of 692 feet, the correction of μ for crown glass and water was only 40″. Hence for the smaller arcs, which were really measured, the corrections were very small, being only 2″·5 for BC, 6″·5 for CD, and 8″ for DE. All the angular distances, therefore, in the preceding table have had this correction applied to them.

M. Fraunhofer then proceeded to determine the index of refraction m for the different fixed lines, and calling σ the angle of incidence, ρ the angle of emergence, ψ the angle of the prism, and m the index of refraction he obtained,

$$m=\sqrt{\left(\frac{(\sin.\ \rho+\cos.\ \psi\ \sin.\ \sigma)^2+(\sin.\ \psi\ \sin.\ \sigma)^2}{\sin.\ \psi}\right)}$$

When the angle of incidence is equal to the angle of emergence, or the angle of deviation a *minimum*, and if μ is the angle of deviation, or that which the emergent ray forms with the incident ray, we have

$$m=\frac{\sin.\ \frac{1}{2}(\mu+\psi)}{\sin.\ \frac{1}{2}\psi}.$$

When the dispersive power of the body under examination is very great, the value of the index of refraction m given by this last formula will not be rigorously correct, as the equality of the angles of incidence and emergence can only take place for one ray. Fraunhofer, therefore, measured the distances BC, CD, or when the distance of the two lines B and C, C and D was the smallest, which takes place when the ray or line which bisects these spaces has its angle of incidence and emergence equal. When the substances have a less dispersive power, or the prisms a smaller angle, the same care is not necessary to obtain this degree of accuracy. If we then call Em the index of refraction for the ray E, we have

$$Em=\frac{\sin.\ \frac{1}{2}(\mu+\psi+DE)}{\sin.\ \frac{1}{2}\psi}.$$

and for the ray F,

$$Fm=\frac{\sin.\ \frac{1}{2}(\mu+\psi+DE+EF)}{\sin.\ \frac{1}{2}\psi}.$$

In this way Fraunhofer obtained the following indices of refraction for the different solids and fluids formerly used:—

Table, shewing the Indices of Refraction corresponding to the Principal Fixed Lines of the Spectrum, in various Media, according to Fraunhofer.

Refracting Media.	B m	C m	D m	E m	F m	G m	H m
Flint glass, No. 13,	1·627749	1·629681	1·635036	1·642024	1·648260	1·660285	1·671062
Crown glass, No. 9,	1·525832	1·526849	1·529587	1·533005	1·536052	1·541657	1·546566
Water,	1·330935	1·331712	1·333577	1·335851	1·337818	1·341293	1·344177
Water,	1·330977	1·331709	1·333577	1·335849	1·337788	1·341261	1·344162
Solution of potash in water,	1·399629	1·400515	1·402805	1·405632	1·408082	1·412579	1·416368
Oil of turpentine,	1·470496	1·471530	1·474434	1·478353	1·481736	1·488198	1·493874
Flint glass, No. 3,	1·602042	1·603800	1·608494	1·614532	1·620042	1·630772	1·640373
Flint glass, No. 30,	1·623570	1·625477	1·630585	1·637356	1·643466	1·655406	1·666072
Crown glass, No. 13,	1·524312	1·525299	1·527982	1·531372	1·534337	1·539908	1·544684
Crown glass,	1·554774	1·555933	1·559075	1·563150	1·566741	1·573535	1·579470
Flint glass, No. 23, prism of 60°,	1·626596	1·628469	1·633667	1·640495	1·646756	1·658848	1·669686
Flint glass, No. 23, prism of 45°,	1·626564	1·628451	1·633666	1·640544	1·646780	1·658849	1·669680

Illuminating power of the spectrum.

Before he proceeded to employ these results to the construction of achromatic telescopes, Fraunhofer endeavoured to determine by exact measurement the illuminating power of the spectrum at different points. In order to do this, he constructed an apparatus represented in figs. 3 and 4, Plate CCCLXXXI. To an eye-glass E, made on purpose for the telescope of the theodolite, he applied a small plane metallic mirror a, the edge of which being well defined, cut the field of the telescope in the middle, as shewn in the figure. It was placed at an angle of 45° to the axis of the object-glass A, and in its focus. The eye-glass E is pulled out till the edge of the small speculum a is distinctly seen. At the side of the eye-glass, and in a direction at right angles to the edge of the speculum a, or to the axis of the telescope, he fixed a tube bcB, cut at the point b in the direction of its length, and in this opening he placed a narrow and a shorter tube MN, whose section is seen at b, crossing the larger tube cB at right angles. A small flame, supplied with oil from an external vessel, was placed in the tube MN, so as to be in the axis of the tube cB. At the point of the narrow tube b or MN, where it was cut by the axis of the tube cB, was a small round aperture for allowing the light of the flame to fall upon the speculum a. Hence it follows that the eye at E will see in half of the field the speculum a illuminated by the flame, and in the other half the colours of the spectrum formed by a prism placed, as formerly described, before the object-glass A. By making the tube MN and the flame approach the speculum, we increase its degree of illumination, and can therefore make it equal to the illumination of the part of the spectrum which we wish to determine. In this way he obtained for each coloured space in the spectrum a certain distance of the flame from the speculum, which afforded a measure of the intensity of illumination, the squares of the distances being inversely as the intensities.

"Though at first sight," says Fraunhofer, "it appears difficult to compare the light of two different colours, yet it becomes easy by a little practice. The intensity of the light of the mirror approaches more to that of any colour in the spectrum, if at the same position of the eye-glass its vertical margin is less distinct. If the mirror is adjacent to a part of the spectrum more or less illuminated, the edge of the mirror becomes, in both cases, more distinct; because, in the first case, the mirror appears to be placed in the shadow, and in the second case, it is the colour of the spectrum that is found there. The experiment with the mirror is a little difficult and uncertain, if we perceive clearly the lines of the spectrum, because the brightest and the darkest lines touch one another almost in every colour. On this account the aperture in the window-shutter is made so broad, that only the strongest lines are just visible, and the fine ones not at all. In place of the mirror outside of the shutter by which the light entered, I put a white plane surface illumi-

Prismatic Spectrum.

nated by the sun, because by any imperfection of the mirror the light is irregularly dispersed, which renders the observations more dubious.

"In order to vary the experiments, I at one time enlarged the round aperture before the flame, and at other times I contracted it. I placed also at the end *c* of the wide tube a piece of ground glass, through which the mirror received its light. In this case I measured the distances of the flame from the ground glass. To avoid all illusion, the aperture before the eye-glass ought to be small, and to be at the place where the principal rays, or the axes of the rays coming from the edge of the field, cut the axis of the telescope. With the prism of flint glass, No. 13, having an angle of $26^\circ 24' 5$, I obtained the following results. Though the experiments were made in clear weather, and at noon, I sometimes perceived, in the course of the observations, a slight change in the density of the light which the prism received. The differences in the four sets of experiments may have been partly owing to this change, and the flame may also have changed its intensity in the course of the observations. If we call the intensity of the light at the brightest part of the spectrum 1, we shall then have,"—

Table, shewing the Intensity of Illumination at different points of the Spectrum.

Points of the Spectrum where the illumination was measured.	Intensity of light.	Intensity of light.	Intensity of light.	Intensity of light.	Mean Intensity, by four experiments.
At the line B,..........................	0·0100	0·044	0·053	0·020	0·032
At ——— C,..........	0·0480	0·096	0·15	0·084	0·094
At ——— D,........................	0·6100	0·590	0·72	0·62	0·640
At 2-7ths of DE from E,...........	1·0000	1·000	1·00	1·00	1·000
At ——————— F,...........	0·4400	0·38	0·61	0·49	0·480
At ——————— F,...........	0·0840	0·14	0·25	0·19	0·170
At ——————— G,...........	0·0100	0·029	0·053	0·032	0·031
At ——————— H,...........	0·00110	0·0072	0·009	0·005	0·0056
	Exp. 1.	Exp. 2.	Exp. 3.	Exp. 4.	

Fraunhofer found the brightest part of the spectrum at the distance of nearly one-third or one-fourth of DE from D.

Plate CCCLXXXI.

The results of the preceding experiments are expressed in the curve, fig. 5, which accompanies the spectrum in fig. 2, the preceding values in the last column of the table being the ordinates of the curve, and the angular distances BC, CD in the table in page 416, for flint glass, No. 13, being the abscissæ.

If we suppose that the quantity of the light in the differently coloured spaces is represented by the areas of the curves BC, CD, we shall obtain the following results, the area of the space DE being made equal to unity.

	Quantity of light in, or area of,
BC............	0·021
CD............	0·300
DE............	1·000
EF............	0·328
FG............	0·185
GH............	0·035

M. Fraunhofer next proceeds to apply these interesting results to the construction of achromatic combinations for telescopes. From the results in the table in p. 416, he obtains the following ratios of the different dispersive powers of the differently coloured rays in the different combinations mentioned in the first column. Achromatic combinations.

Table, shewing the Ratios of the Dispersion of the differently coloured rays for each combination of Media.

Refracting Media.	$\frac{Cn'-Bn'}{Cn-Bn}$	$\frac{Dn'-Cn'}{Dn-Cn}$	$\frac{En'-Dn'}{En-Dn}$	$\frac{Fn'-En'}{Fn-En}$	$\frac{Gn'-Fn'}{Gn-Fn}$	$\frac{Hn'-Gn'}{Hn-Gn}$
Flint glass, No. 13, and water,........	2·562	2·871	3·073	3·193	3·460	3·726
Flint glass, No. 13, and crown glass, No. 9,....................	1·900	1·956	2·044	2·047	2·145	2·195
Crown glass, No. 9, and water,.......	1·349	1·468	1·503	1·560	1·613	1·697
Oil of turpentine and water,..........	1·371	1·557	1·723	1·732	1·860	1·963
Flint glass, No. 13, and oil of turpentine,....................	1·868	1·844	1·783	1·843	1·861	1·899
Flint glass, No. 13, and kali,.........	2·181	2·338	2·472	2·545	2·674	2·844
Kali and water,........................	1·175	1·228	1·243	1·254	1·294	1·310
Oil of turpentine and kali,............	1·167	1·268	1·386	1·381	1·437	1·498
Flint glass, No. 3, and crown glass, No. 9,....................	1·729	1·714	1·767	1·808	1·914	1·956
Crown glass, No. 13, and water,......	1·309	1·436	1·492	1·518	1·604	1·651
Crown glass and water,...............	1·537	1·682	1·794	1·839	1·956	2·052
Crown glass, No. 2, and crown glass, No. 13,....................	1·174	1·171	1·202	1·211	1·220	1·243
Flint glass, No. 13, and crown glass,	1·667	1·704	1·715	1·737	1·770	1·816
Flint glass, No. 3, and crown glass,...	1·517	1·494	1·482	1·534	1·579	1·618
Flint glass, No. 30, and crown glass, No. 13,....................	1·932	1·904	1·997	2·061	2·143	2·233
Flint glass, No. 23, and crown glass, No. 13,....................	1·904	1·940	2·022	2·107	2·168	2·268

ismatic ectrum.

The important results embodied in the preceding table, completely overturn the opinion of Dr. Wollaston respecting the proportionality of the different colours, and establish beyond all question the *irrationality* of the coloured spaces. In the very first combination, for example, of *flintglass* and *water*, the ratio of the dispersion of the rays in the *red* space BC, is as 1 to 2·56, whereas in the *violet* space GH, it is as high as one to 3·726. In the combination of *flint glass* and *oil of turpentine*, we have a case where the irrationality is very trifling, and what Fraunhofer has not observed, the irrationality is nothing between the *orange* and *blue* spaces, and almost nothing between the *red* and *indigo*, but very considerable between the *green* and all the other spaces, and a maximum between the green and the violet. The differences of the ratios, too, are *negative* or diminishing in the two first or least refrangible spaces, and *positive* in all the rest, the *negative* differences nearly balancing the *positive* ones; whereas, with very trifling exceptions, the ratios increase towards the most refrangible extremity of the spectrum.

It is obvious that in the construction of achromatic object-glasses of flint and crown glass, there must always be a considerable portion of outstanding colours or *aberrations*, as Fraunhofer calls it. Hence in place of making the focal lengths of the two lenses in the exact ratio of their dispersive powers, we must alter the ratio so as to make the outstanding colours a minimum for the distinct vision of objects. But in order to do this, we must take into account the intensity of illumination in the coloured spaces; for it is obvious that a given irrationality in the yellow spaces, will, from the intensity of its illumination, be much more regarded than a similar irrationality in the violet space. As the outstanding rays, therefore, will be injurious to distinct vision in proportion to their intensity, the distinctness will be a maximum, as Fraunhofer has shewn, when the ratio of dispersion x is taken, such that

$$x=\frac{b\beta+c\gamma+d\delta+e\epsilon+f\xi+g\eta}{\beta+\gamma+\delta+\epsilon+\xi+\eta}$$

in which case we have

$$(x-b)\,\beta+(x-c)\gamma+(x-d)\delta+(x-e)\epsilon+(x-f)\xi+(x-g)\eta=0$$

where β, γ, δ, ϵ, &c. express the quantity of light in the spaces BC, CD, DE, &c. and b, c, d, e, &c. the quotients or ratios of dispersion $\frac{\mathrm{C}m'-\mathrm{B}m'}{\mathrm{C}m-\mathrm{B}m}$, $\frac{\mathrm{D}m'-\mathrm{D}m'}{\mathrm{D}m-\mathrm{B}m}$ &c.

This ratio, or the value of x calculated for *flint glass*, No. 30, and *crown glass*, No. 13, is as 1 to 2·012; but Fraunhofer found that in an object-glass, consisting of these two kinds of glass, the distinctness was a maximum when the ratio was as 1 to 1·98.

Fi lines in light.

To the Chevalier Fraunhofer we owe also the discovery of fixed lines in the light of the planets and fixed stars. As the light of our sun is defective in so many rays, it was to be expected that the light of all the planets which he illuminates, would be equally defective in the same rays. In the brighter colours of the *Moon's* spectrum, we find the same fixed lines as in the sun's light, and in the same place. The spectra from the light of *Mars* and *Venus* contained the lines D, E, *b*, and F, of solar light, and precisely in the same place. In the spectrum of *Sirius* he was unable to perceive fixed lines in the *orange* and *yellow* colours, but in the *green* he saw a very strong streak, and in the *blue* other two very strong ones, having no resemblance to any of the lines in the solar spectrum. *Castor* gives a spectrum resembling that of *Sirius*. The streak in the green was so intense, that notwithstanding the weakness of the light, yet he ascertained by measurement that it occupied the same place as the green streak in Sirius. He distinguished also the two streaks in the blue, but he could not ascertain their place. In the spectrum of *Pollux* he found many weak and fixed lines, which resembled those of *Venus*. The line D he saw distinctly, and occupying the same place as in the pure light. In the spectrum of *Capella*, he saw the lines D and *b*, as in solar light. The spectrum of *Betalgeus* contains numerous fixed lines, which in a favourable atmosphere are sharply defined. There were lines like the solar ones D and *b*. In the spectrum from *Procyon*, some lines were perceived with difficulty, but they were not sufficiently distinct to be measured. In the orange space, however, he saw a line at D.

Prismatic Spectrum.

Sect. VI.—*On the Physical Properties of the Spectrum.*

Physical properties of the spectrum.

The physical properties of the spectrum, which have been the subject of experimental investigation, are its *heating* power, and the *chemical* and apparently *magnetical* influence of its rays.

Heating power.

Heating power of the spectrum. That the heat of the coloured rays should be most intense where their light was strongest, was long the general belief of philosophers; and Landriani Rochon,[1] and Sennebier, found by direct experiment that the highest temperature existed in the *yellow* space. Sir W. Herschel, however, found that the heating power increased from the *violet* to the *red* space, and that the thermometer continued to rise when placed beyond the visible red extremity of the spectrum. He therefore drew the conclusion that there were invisible rays in the light of the sun which had the power of producing heat, and which had a less degree of refrangibility than red light. Sir W. Herschel attempted, in vain, to determine the index of refraction of the extreme invisible ray which possesses the power of heating; but he ascertained that at a point one-and-a-half inches distant from the extreme red ray, the invisible rays exerted a considerable heating power, even though the thermometer was placed at the distance of fifty two inches from the prism.

Sir W. Herschel.

Sir Henry Englefield.

In 1801, Sir Henry Englefield repeated these experiments; but he does not acquaint us with the kind of glass of which his prism was made. He obtained the following results, which confirm those of Sir William Herschel.

Colours of the Spectrum.	Temperature, Fahr.
Blue	56
Green	58
Yellow	62
Red	72
Beyond Red	79

From our author's own account of the method of making these experiments, we place no confidence in the principal result respecting the invisible rays. "*As I had nothing to do with light*," says he, "it was not necessary to darken the room; and as I wished to accumulate as large a portion of solar heat as possible, *I placed the prism in an open window*." As the whole interest of these experiments was concentrated in the determination of *invisible* heating rays, Sir Henry had a great deal to do with light, as the whole question turned upon an exact appreciation of the *termination of the spectrum*. In a dark room the spectrum is much longer than in open day, and we have reason to believe from experiment, that Sir Henry Englefield's spectrum did not visibly extend beyond the line C of Fraun-

[1] The Abbé Rochon used a prism of flint glass, and a thermometer containing spirits of wine, and he found the maximum temperature in the *yellow orange* rays See his *Opsucules*, 1783.

Dr. Hutton, in his *Philosophy of Light and Heat*, Edin. 1794, p. 38, remarks that, "the compound light which is *white*, has a greater power of giving vision in proportion to its power of exciting heat; whereas in the *red* species, it is the opposite, for here the power of exciting heat is great in proportion to its power of giving vision."

Prismatic Spectrum

hofer, so that his maximum temperature of 79° was actually found in the red rays.

Recent experiments.

With the view of throwing light upon this subject, Sir David Brewster has endeavoured to ascertain the visible extent of the spectrum by various methods of condensing the light, and absorbing by coloured media, the luminous parts of the spectrum. By these means he has traced the visible spectrum, and the fixed lines in it as far beyond the line A as the distance of the group of lines *a* is from A, and has seen it indistinctly to a distance as great as AB beyond A. Hence there cannot be the least doubt that the experiments beyond the visible red were actually made when the thermometer was placed in the red space. He does not, however, conclude from this that there are no invisible rays beyond the red; but merely that the experiments of Herschel and Englefield were made in a part of the spectrum where rays of light actually exist. On the contrary, our author concludes that there are rays of heat of all degrees of refrangibility, and consequently consisting of waves of all degrees of breadth and velocity. When produced by a slight vibratory movement, the waves of heat are broad and slow; as the temperature rises they become narrower and quicker in their motion. When their velocity is such as to equal that of the extreme red ray, they become faintly visible, and the other colours are successively produced by quicker motion, till white light is radiated. This seems to be the process by which incombustible bodies are gradually raised from the deepest red to the brightest white; and if we examine, by means of a prism, the changes which take place in the gradually increasing light, we shall find that the different rays of the spectrum are successively added to the red light.[1] He conceives, therefore, that the sun emits rays of all degrees of refrangibility, extending probably far beyond the visible extremity of the violet, and though not capable of being rendered sensible, yet exercising powerful influences in the economy of nature.

Berard.

M. Berard, and Sir Humphry Davy obtained results analogous to those of Sir W. Herschel; M. Berard finding the maximum heat at the very extremity of the red ray, and Sir H. Davy beyond it.

Wunsch.

The most valuable series of experiments on this subject, were made by Professor Wunsch, and Dr. Seebeck of Berlin. So early as 1807, Professor Wunch[2] had made experiments with *prisms* of various substances, and obtained the following results:

Substances of which the Prisms were made.	Place of maximum heat.
Alcohol	Yellow space.
Oil of turpentine	Yellow space.
Water	Yellow space.
Green glass	Red.
Yellow glass	Extreme red.

Seebeck.

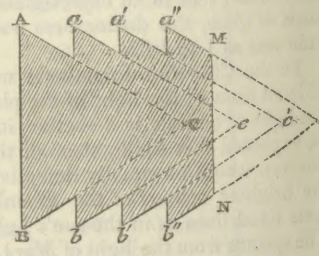
These results were confirmed by Dr. Seebeck, who obtained the following new results:

Substances of which the prisms are made.	Place of maximum heat.
Sulphuric acid concentrated	Orange.
Solution of sal-ammoniac	Orange.
Solution of corrosive sublimate	Orange.
Crown glass	Middle of red.
Plate glass	Middle of the red.
Flint glass, English	Beyond the red.
Flint glass, Bohemian	Beyond but nearer the red

The explanation which was given of these results, (which had been ascribed to different prisms of refracting caloric,[3]) by Sir David Brewster, accounts in a very satisfactory manner for all the phenomena. He conceives that transparent bodies have the same power of absorbing or stopping certain rays of the thermometric spectrum, as Dr. Robison called it, in the same manner as *coloured* bodies have the power of stopping certain rays of the luminous spectrum. These last bodies necessarily became coloured by stopping certain rays; but as the eye is not sensible to heat in the same manner as to light, the absorptive power of transparent bodies for heat can only be proved by the thermometer. He considers *water* as the type of bodies which are uniformly transparent for heat, as its maximum of heat coincides with its maximum of light. A prism of crown glass, on the contrary, is less uniformly transparent for heat; and its maximum of heat is in the red space, because it has absorbed much of the heat in the yellow space. In like manner flint glass has absorbed more of the heating rays in the red than the crown glass, and hence its maximum is about the extremity of the red, or beyond the end of the spectrum as commonly seen. In coloured media the maximum ordinate of their luminous spectrum, shifts along the whole prismatic spectrum; sometimes there are *two* or *more maxima* of light, and sometimes narrow and wide spaces entirely defective in light. Hence Sir David Brewster[4] supposes that there are defective spaces, and lines in the thermometric spectrum.

This view of the subject suggests a new mode of investigating the phenomena of the heating rays. If we take a prism of coloured glass to investigate the dark spaces and lines produced by absorbing media, we shall only have a very imperfect approximation to the true result; that is, we never could have absolutely dark spaces in the spectrum, as long as all the rays that went to the formation of the spectrum, passed through *all the different thicknesses of the prism*. The thinnest parts of the prism allow all the rays to pass, and consequently illuminate the whole spectrum, so that the actions of various thicknesses of the media are confounded, and the real absorptive action at a given thickness concealed. In like manner in the spectrum of heat, the heating rays which pass through the thin parts of the prism, will throw heat into every part of the spectrum; and hence the experiments should be made with the frustums of prisms, where the difference of thickness is small, and the want of area made up by an increased height of the prism. The best way, however, of making the experiments, would be to use a compound prism constructed as in the annexed figure, where AB, MN, is the section of a compound prism consisting of four frusta of prisms, AB, *ab*, *a'b'*, &c. the frustum AB, being part of a prism ABC. the frustum *ab*, part of a prism *abc*, &c. or this compound prism, in place of being ground out of the mass, which would be difficult though practicable, might be composed of a single prism ABC, with parallel plates of the same glass added by cement so as to compose the notched parallelogram ABMN. Very interesting results might also be obtained by using spectra formed by interferences in the manner we shall afterwards describe.

Fig. 86.



In all experiments with fluid prisms, the results are perplexed with the effects of the plates of glass by which the prisms are confined, in the same manner as we would disturb and indeed nullify the results respecting the absorption of light

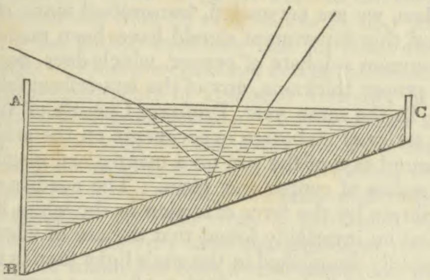
Prismatic Spectrum.

[1] See Professor Powell's valuable *Report on Radiant Heat, British Association Reports*, vol. i. p. 295.
[2] *Magazine der Gesellsch.* &c.
[3] Turner's *Chemistry*, 3d Edit. p. 84.
[4] Professor Powell's *Report*, p. 293, 294.

[Pri]smatic [Spe]ctrum.

by coloured fluids, were we to confine them in hollow prisms made of coloured glass. The only method of remedying this defect in the experiment, would be to form the spectrum by a prismatic vessel of the fluid, whose upper surface AC, is formed by gravity, and its lower surface BC, by a plate of highly polished silver, which reflects back the spectra through the first surface.

Fig. 87.



According to Berard's experiments, the calorific rays of the spectrum are capable of being doubly refracted and polarised like those of light, and he obtained the same result with culinary heat;—the heat of a dark body below redness, being substituted for solar heat.[1]

C[hem]ical eff[ect]s of th[e sp]ec-tr[um].

On the chemical effects of the spectrum. It was long ago observed by Scheele that muriate of silver was rendered much blacker in the violet rays of the spectrum, than in any other part of it.[2] In the year 1801, Professor Ritter of Jena exposed muriate of silver in various parts of the spectrum, and also beyond its apparent limits. He found that the action was least of all in the red rays, greater in the yellow, greater still in the blue and violet, and greatest of all beyond the *visible* violet rays. Dr. Wollaston and M. Beckman obtained a similar result, apparently without knowing what had been done by Ritter. In repeating the experiments of Scheele with white muriate of silver, "he found that the blackness extended not only through the space occupied by the violet, but to an equal degree, and to about an equal distance, beyond the visible spectrum; and that by narrowing the pencil of light *the discoloration may be made to fall* ALMOST ENTIRELY beyond the violet. It would appear, that this and other effects usually attributed to light, are not in fact owing to any of the rays usually perceived, but to *invisible* rays that accompany them; and that if we include two kinds that are invisible, we may distinguish upon the whole *six* species of rays into which a sunbeam is divided by refraction."[3]

M[uria]te of sil[ver].

The phrase *almost entirely* beyond the violet, used by Dr. Wollaston, cannot be considered as indicating the existence of invisible rays, even if we did not know from the experiments of Fraunhofer and others, that the visible violet space extends greatly beyond the place where both Ritter and Wollaston found the muriate of silver to be blackened. The existence of invisible rays, therefore, however probable, cannot be regarded as a scientific fact.

Gum [gu]ia-cum.

The chemical action of the least refrangible rays upon gum guiacum was discovered by Dr. Wollaston. Having washed a card with a solution of this gum in alcohol, he found that it acquired a *green* colour from the concentrated violet and blue rays. No change of colour was effected by heat; but in the red rays the tinged card lost its *green* and recovered its original colour. When the tinged card was placed in carbonic acid gas, the violet rays could not make it green; but when made green as before, it was speedily restored to its original yellow colour by the red rays. As Dr. Wollaston found that the back of a heated silver spoon restored the green colour as well as the red rays, we cannot attach any definite meaning to these experiments.

Prismatic Spectrum.

Hydrogen and chlorine

MM. Gay Lussac and Thenard discovered a very energetic chemical action of the solar rays. On exposing to a pencil of solar light, a mixture of hydrogen gas and caloric, in equal volumes, a detonation of the mixed gases took place, and hydrochloric and (muriatic acid) was formed.

M. Berard.

M. Berard repeated the experiments with muriate of silver, and with the preceding mixture of gases which he placed in the different coloured spaces of the spectrum, and he found that the chemical action was in every case more powerful towards the violet extremity and a little beyond it. M. Berard likewise concentrated the least refrangible half of the spectrum by means of a lens, and then the most refrangible half. The latter, though the most intense, produced no effect upon the muriate of silver, but the former blackened it in less than ten minutes.[4]

Mrs. Somerville.

Mrs. Somerville,[5] found that the chemical rays passed as freely through blue glass coloured with cobalt, as through colourless glass. Having dipped a piece of paper in a solution of muriate of silver, and cut it into two parts, one of them was placed under a blue glass, and the other under a white glass at the same instant. The one did not become black more than the other, and there was no difference in the intensity of their colour.

Dr. Young.

Dr. Thomas Young made a very interesting experiment with the view of determining if the invisible chemical rays interfered with the luminous ones. He produced the Newtonian rings with a thin plate of air, and having formed an image of them by means of the solar microscope, he threw this image upon paper dipped in a solution of nitrate of silver, and placed it at the distance of about nine inches from the microscope. "In the course of an hour," says he, "portions of three dark rings were very distinctly visible, much smaller than the brightest rings of the coloured image, and coinciding very nearly, in their dimensions, with the rings of violet light that appeared upon the interposition of violet glass. I thought the dark rings were a little smaller than the violet rings, but the difference was not sufficiently great to be accurately ascertained. It might be as much as one-thirtieth, or one-fortieth of the diameter, but not greater."[6]

M. Arago.

A more decisive experiment was afterwards performed by M. Arago, who formed a set of fringes, by the interference of two solar pencils, proceeding from a common origin, and having kept them very steadily for a long time upon the same part of a piece of paper rubbed with muriate of silver, a series of black lines were traced upon leaving their intervals, smaller than those of the dark and bright fringes formed by violet light.

Sir John Herschel.

In the summer of 1831, we had the satisfaction of being shewn by Sir John Herschel a very interesting experiment on the chemical action of the violet rays. When a solution of platinum in nitro-muriatic acid[7] is mixed with lime water, no precipitation to any considerable extent takes place in the dark, a slight flocky sediment only being formed after long standing. But if a fresh mixture, or an old one cleared by subsidence of this sediment, is exposed to the sun's rays, it instantly becomes milky, and a *white* precipitate is copiously formed. If the solution of platina is in excess, the precipitate is of a pale yellow colour. In the common light of a cloudy day, the same effect is produced more slowly. When tubes containing the mixture are exposed within red fluids, or even yellow ones which absorb the violet rays, no precipitation takes place.

The following remarkable facts were published in the *Journal de Pharmacie* for March 1832, but the abstract

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[1] *Mem. de la Societé d'Arcueil*, 1817, tom. iii. A full account of these experiments, occupying a whole chapter of eighteen pages, will be found in Biot's *Traité de Physique*, tom. iv. p. 600.

[2] *Traité de l'Air et du Feu*, § 66.

[3] *Phil. Trans.* 1802.

[4] *Biot's Traité de Physique*, tom. iv. p. 673, 674.

[5] *Phil Trans.* 1826, part ii. p. 136.

[6] *Elements of Nat. Phil.* vol. ii. p. 647

[7] The excess of acid must be neutralised by the addition of lime, and the solution well cleared by filtration.

[8] See *Lond. and Edin. Phil. Mag.* No. 1, July 1832, p. 58.

Prismatic Spectrum.

from which we quote them, does not mention the name of the author.[1] A solution of peroxalate of iron, when kept in the dark or exposed to the heat of boiling water, suffers no change; but if it is exposed to the sun's rays, an infinite number of bubbles of carbonic acid are disengaged, and the solution is like a syrup undergoing strong fermentation.

A solution of muriate of platinum is decomposed by the oxalic acid, and the oxalates by the sun's light, with almost as energetic a disengagement of gas as the solution above mentioned.

Muriate of gold, when reduced by oxalic acid through the agency of light, covers the interior surface of the vessel with an uniform brilliant gilding, which is of a pure green colour by reflected light.

Oxalate of silver under water, is partially decomposed by solar heat (not by culinary heat) into metallic silver and carbonic acid. If the reddish brown solution of muriate of iridium in water, mixed with oxalic acid and heated to ebullition, is exposed to the sun, total discoloration promptly takes place, carbonic acid is disengaged, and grey metallic iridium precipitated.

Magnetic influence of the solar rays.

Magnetic influence of the solar rays.—Though many interesting and apparently accurate experiments have concurred to indicate the existence of this property of light, yet recent inquiries have thrown a considerable doubt upon the conclusions which have been drawn from them. Dr. Morichini, a Roman physician, first succeeded in 1813, in magnetising small needles, by making a focus of the violet rays, collected by a lens, pass repeatedly from the middle to one end of a needle, without touching the other half. By continuing this process for an hour, the needle had acquired distinct polarity. This experiment was repeated successfully by the Marquis of Ridolfi and M. Carpa; and Sir H. Davy and Professor Playfair, and other English philosophers, witnessed the successful performance of this experiment. Professor Configliachi at Rome, with the benefit of an Italian sun, M. Berard of Montpellier, and M. Dhombre Firmas at Alais, failed in obtaining similar effects from the violet rays, and hence the doctrine of the magnetic efficacy of blue light was exploded both by the French and Italian philosophers.

Mrs. Somerville.

In 1825 Mrs. Somerville repeated, in a different way, the experiments of Morichini. She took a slender sewing needle an inch long, quite devoid of magnetism, and having covered half of it with paper, she fixed it to the pannel of the wall with wax, so that its uncovered half should receive the violet rays of a spectrum formed by an equianglar prism of flint glass, whose refracting faces were each 1·4 by 1·1 inches, and which was placed about five feet from the wall. The needle was placed in a vertical plane nearly perpendicular to the magnetic meridian, and inclined to the horizon, and as the sun advanced to the meridian, the needle was moved parallel to itself to keep it in the sun's rays. In less than two hours, when the sun had just passed the meridian, the exposed half of the needle attracted the south and repelled the north pole of the magnetic needle. A second experiment on the same day confirmed this result, and similar effects were obtained by varying the circumstances of the experiment.

In the blue and green rays, the needles were magnettised but less frequently, and always after a longer exposure, but the magnetism was always as strong as in the violet. The indigo rays were nearly as efficacious as the violet. Pieces of clock and watch spring were also magnetised after longer exposure, and magnetic needles had their magnetism increased by the same means. When the violet rays were concentrated with a lens, the magnetism was sooner conveyed to the needle. When the halves of the needles and the pieces of spring were enveloped in violet and green silk, they became magnetic also. Mrs. Somerville does not seem to have tried as a check upon these results, the action of the *red* rays of the spectrum. The blue glass, we are persuaded, transmitted many of the red rays, and this experiment should have been made by using the common sulphate of copper, which does not transmit, with a proper thickness, any of the less refrangible rays.[2]

Professor Christie.

In the same year, Professor Christie of Woolwich, made a series of elaborate experiments on the action of the compound rays of the sun on a magnetised needle, and also on needles of copper and glass. The needles were caused to vibrate by the force of torsion in the white light of the sun, and he invariably found that the arc of vibration was more rapidly diminished in the sun's light than in the shade. Professor Christie regards these facts as proving incontestibly the existence of a magnetic influence in the solar rays, and tending to restore the credit of Morichini's experiments. He intended to make his needles vibrate under the separated rays of the sun, and had an apparatus prepared for the purpose; but we are not aware of his having either made these experiments or published any account of them.[3]

Baumgartner.

M. Baumgartner of Vienna,[4] while repeating the experiments of Mrs. Somerville, found that a steel wire, some parts of which were polished, while the rest were rough or without lustre, were magnetised by the action of the white light of the sun, each polished part exhibiting a *north*, and each unpolished part a *south* pole. By concentrating the sun's rays, the effect was produced more rapidly. On a wire eight inches long, he thus obtained eight poles. When the needles were perfectly oxidated or perfectly polished, or had polished lines in the direction of their lengths, he could not succeed in magnetising them.

Barlocci.

A less equivocal method of proving the magnetic influence of white light presented itself to Professor Barlocci. An armed natural loadstone capable of carrying a weight of 1½ Roman pounds (a Roman lb. is equal to 339·179 grammes) after *three hours* exposure to the strong light of the sun, was able to carry 2 oz. or one-sixth of a lb. more, and after an exposure of 24 hours its force was almost *doubled*. A second loadstone of nearly the same power was put into a dark place of the same temperature as that of the solar rays, but acquired no additional strength. A stronger magnet, which carried 5 lbs. 5 oz. and 2 deniers, was exposed to the light of a cloudy and humid atmosphere, and where it snowed; but it acquired no additional power; while, during the two subsequent days under a clear sky, its energy was more than doubled. The effect was not increased by a lengthened exposure.

Zantedeschi.

Among the most active labourers in this department of science, we must rank M. Zantedeschi of Pavia.[5] He had early obtained results similar to those of Morichini, and about the end of 1825, he had remarked, that suspended wire needles, devoid of all magnetism, and having one of their ends exposed to the white light of the sun under a glass receiver, turned that extremity to the north in the plane of the magnetic meridian. In repeating the experiment of Barlocci with artificial magnets, M. Zantedeschi found that a horse-shoe magnet, carrying 13½ ounces, carried 3½ oz. more after three days exposure to the sun, and by continued exposure, was able to carry 31 oz. He found also that the strength of oxidated magnets was increased by solar light, and that it diminished in those that were not oxidated. A loadstone, for example, not oxidated, lost 2½ oz. of its strength by three hours exposure to solar light, whilst another oxidated and similarly exposed, gained as much and even more strength. When the first was polished like a mirror, its strength suffered no change by a prolonged exposure to the

1 *Id. Id.* June 1832, p. 466. 2 *Phil. Trans.* 1826. p. ii. p. 132. 3 *Id. Id.* p. 219—239. 4 *Zeitscrift*, tom. 1. p. 263.
5 *Edinburgh Journal of Science*, No. V. N.S. 1830, p. 76.

[Pri]smatic [Spec]trum.

[Pri]smatic sun. He likewise found that when a loadstone, whether oxidated or not, had its *north pole* exposed to the sun, it *acquired strength*, but *lost strength* when its south pole was exposed. In more than sixty experiments, the increase of strength varied from 1 to 2, and to 3½ oz. whereas the corresponding diminution was from 3½ to 5, and to 5½ oz. In these experiments our author confesses that he often encountered anomalies of which he could not detect the cause.

In repeating the experiments of Professor Christie, M. Zantedeschi obtained analogous results. Having placed a magnetic needle a foot long *in the shade*, he drew its place of rest through an arch of 90°, and it performed in 30″ four oscillations, the last of which had a semi-amplitude of 70°. When exposed *to the solar rays*, it performed in the same time, and under the very same circumstances, four oscillations, the last of which had only a semi-amplitude of 60°.

Ri[ess] and Mo[ser].

A great degree of doubt has been cast upon the conclusiveness of all these researches, by a series of well-managed experiments made recently by MM. Riess and Moser. The following experiments were made after the manner of Morichini. The needles were made of soft steel; their mass was very small, and they presented a considerable surface to the action of the light. The prism was placed in the position of minimum deviation, which corresponds to the greatest intensity of the light of the spectrum, the needles were placed on a graduated circle, three or four feet from the prism. The lens used had an aperture of 1·2 inches, and a focal length of 2·3 inches, and by it the focus of the violet rays was made to traverse one-half of the needle 200 times, excepting on the 10th July and the 12th August, when it was done only 100 times, and on the 25th July, when it was done 525 times. The following were the results which they obtained, shewing no change in the number of oscillations.

Dates.	Names of the Needles.	Duration of Oscillations. Before experiment.	Duration of Oscillations. After experiment.	Time of Observation.
April 3,	*a*	22″·0	22″·0	10½ 12
—— 27,	*b*	27 ·5	27 ·5	9½ 11
	c	14 ·5	14 ·5	9½ 11
May 6,	*d*	3 ·0	3 ·0	8½ 10
June 14,	*e*	15 ·2	15 ·7	9 12
—— 16,	*f*	22 ·0	22 ·0	9¾ 11¾
—— 17,	*f*	22 ·7	22 ·5	8¾ 11¾
—— 23,	*g*	18 ·2	18 ·2	9 10¾
July 1,	*f*	23 ·0	23 ·7	9¼ 12¼
——,	*h*	19 ·5	19 ·5	9¼ 12¼
—— 11,	*f*	22 ·4	22 ·2	8½ 10¾
——,	*i*	27 ·7	22 ·5	8½ 10¾
—— 25,	*f*	19 ·5	19 ·2	9¼ 11
Aug. 10,	*f*	22 ·0	22 ·2	9 12
——,	*k*	20 ·2	20 ·0	9 12
—— 12,	*f*	22 ·2	22 ·2	9 11½
——,	*l*	17	16 ·7	9 11½

As *reflected* light was not used in Morichini's experiments, which our author wished to verify, they employed the *direct* light of the sun. In the experiments, however, with the needles *a*, *b*, *c*, they fixed the spectrum by means of a heliostate. They remark that the needle had been exposed 17½ hours to the action of the sun without becoming magnetic, whereas Morichini succeeded in magnetising his needles in from fifteen to thirty minutes.

These gentlemen repeated also in a similar manner the experiments of Baumgartner, but it would be unprofitable to detail them here, as they could not reproduce any of the results which he had obtained. They tried also the action of polarised light, but without any better success.[1]

Sect. VII.—*Recent Discoveries respecting the Spectrum.*

Prismatic Spectrum.

New analysis of the spectrum.

The analysis of white or compound light by the prism was made and perfected by Sir Isaac Newton; but though the prism could not decompose them, he committed a mistake in concluding that the colours of the spectrum were simple and homogeneous; "that to the same degree of refrangibility ever belonged the same colour, and to the same colour ever belonged the same degree of refrangibility." Now, though it is quite true that the *green* and *orange* colours of the spectrum cannot be decomposed *by the prism* into more simple ones, the one into *blue* and *yellow*, and the other into *yellow* and *red*, yet they can be decomposed by other means. This opinion respecting the compound nature of the colours of the spectrum, and the inability of the prism to analyse them, was first maintained by Sir David Brewster,[2] who, with the view of placing it beyond a doubt, undertook a series of experiments, in which he examined the effects produced on the solar spectrum by viewing it through a great number of coloured media, and reflecting it from coloured. By these experiments, he not only established the accuracy of his first opinion, that the *green* and *orange* colours of the spectrum were compound, the one consisting of *blue* and *yellow*, and the other of *red* and *yellow*, but was led to the more general result, that the whole spectrum was compound, consisting of three equal and superposed spectra of *red*, *yellow*, and *blue* light.[3] The following are the general results which he obtained:—

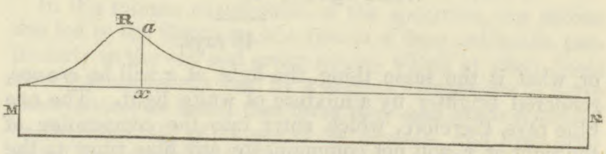
"1. White light consists of *three* simple colours, *red*, *yellow*, and *blue*, by the mixture of which all other colours are formed.

"2. The solar spectrum, whether formed by prisms of transparent bodies, or by gratings or grooves in metallic and transparent surfaces, consists of *three* spectra of *equal length beginning and terminating at the same points*, viz. a *red* spectrum, a *yellow* spectrum, and a *blue* spectrum.

"3. All the colours in the solar spectrum are *compound* colours, each of them consisting of *red*, *yellow*, and *blue* light in different proportions.

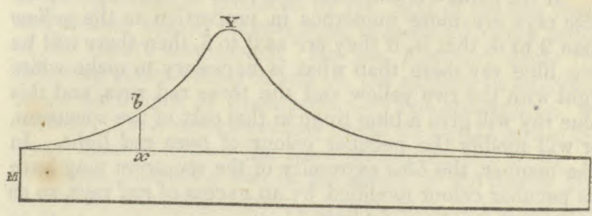
"4. A certain quantity of *white light*, incapable of being decomposed by the prism, in consequence of all its component rays having the same refrangibility, exists at every

Fig. 88.



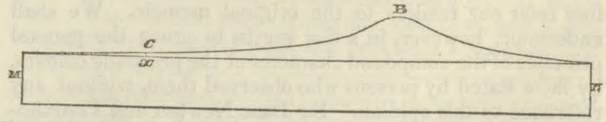
Red.

Fig. 89.



Yellow.

Fig. 90.



Blue.

[1] See *Annales de Chimie*, 1829.

[2] *Edinburgh Transactions*, vol. ix. p. 48.

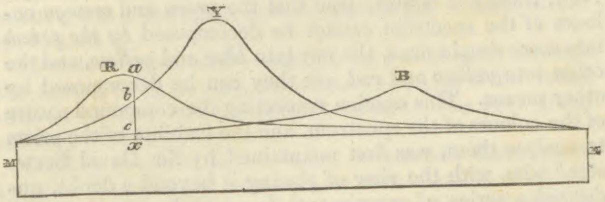
[3] *Id. Id.* vol. x. p. 123.

Prismatic Spectrum.

point of the spectrum, and may, at some points be exhibited in an insulated state.

"This remarkable structure of the spectrum will be better understood from figs. 88, 89, 90, which represent the three separate spectra, which are shewn in their combined state in fig. 91.

Fig. 91.



"In all these figures, the point M corresponds with the *red*, or *least refrangible* extremity of the spectrum, and N with the *violet* or *most refrangible* extremity; and the ordinates ax, bx, cx, of the different curves MRN, MYN, MBN, represent the intensity of the *red*, *yellow*, and *blue* ray at any point x of the spectrum.

"If the distance Mx in all these spectra be equal, then, in the combination of them shewn in fig. 91, the ordinates ax, bx, cx, will indicate the nature and intensity of the colour at any point x of the red spectrum. Thus, let

"The ordinate for *red* light $ax=30$,
yellow $bx=16$,
blue $cx=\ 2$,

$$ax+bx+cx=48 \text{ rays,}$$

then the point x will be illuminated with 48 rays of light, viz., 30 of red, 16 of yellow, and 2 of blue light.

"Now, as there must be certain quantities of red and yellow light which will form white, when combined with two blue rays, let us assume these, and suppose that white light, whose intensity is 10, will be formed by 3 red, 5 yellow, and 2 blue rays; hence it follows that the point x is illuminated by

"Red rays,.........27
Yellow rays,.......11
White light,......10

48 rays,

or, what is the same thing, the light at x will be *orange*, rendered brighter by a mixture of white light. The *two* blue rays, therefore, which enter into the composition of the light at x, will not communicate any blue tinge to the prevailing colour.

"If the point x is taken nearer M, and if, at that point, the *blue* rays are more numerous in proportion to the *yellow* than 2 to 5, that is, if they are as 3 to 5, then there will be one blue ray more than what is necessary to make white light with the two yellow and the three red rays, and this blue ray will give a blue tinge to that part of the spectrum, or will modify the peculiar colour of *pure red* light. In like manner, the *blue* extremity of the spectrum may have its peculiar colour modified by an excess of *red* rays, so as to convert it into *violet* light."

It would occupy too much space to bring forward the body of evidence which supports these views, and we must therefore refer our readers to the original memoir. We shall endeavour, however, in a few words, to prove the general principle of the compound character of the prismatic colours, by facts stated by persons who observed them, without any reference to this opinion. Sir Isaac Newton and Fraunhofer, and many persons besides, have, from long observation of the solar spectrum, concluded that there is a *homogeneous unmixed yellow*, and a *homogeneous unmixed orange* space in the spectrum. Newton makes the *yellow* space 40, and the *orange* 27, or 67 in all; while Fraunhofer makes the *yellow* space 27, and the *orange* space 27, or 54 parts of a spectrum whose length is 360 parts. Now, Dr. Wollaston declares that a beam of daylight is refracted by the prism into *five colours* ONLY, *red*, *yellowish green*, *blue*, and *violet*, and he defines their limits with his usual accuracy. Dr. Young, who repeated the same experiments with that exactness which was peculiar to him, declares that the spectrum formed in Dr. Wollaston's manner, consists of *four colours* ONLY, *red*, *green*, *blue*, and *violet*, "the colours differing scarcely at all in quality within their respective limits." Now both these accurate observers have rejected the *yellow* and *orange* spaces almost entirely, with the exception of the narrow line of yellow light formerly mentioned, thus running counter to all the observations of Newton and Fraunhofer. The cause of such a difference is this: The light analysed by Wollaston was the *blue light of the sky*, which had been deprived by absorption of many of its rays, having the same refrangibility as those which fell upon the prism. Dr. Young's *green* space was Sir Isaac Newton's *yellow* space, deprived of most of its *yellow* rays, and the *red* space adjoining the green was Newton's *orange* space, deprived by the absorption of the atmosphere, of almost all its yellow rays; and the sharp yellow line noticed by Dr. Young, and regarded by Dr. Wollaston as a mixture of red and green light, as if these spaces had overlapped a little, is part of the *orange* space of Fraunhofer and Newton, deprived of its *red* rays. This *yellow* band can be produced artificially upon all kinds of white light, and by the absorption of various media. Hence it is obvious, that by comparing the light reflected and modified by the *blue sky* with the direct *light of the sun*, we may obtain irrefragable proof of the compound nature of the yellow and orange spaces. That *red* light exists at the most refrangible extremity, is obvious from its *violet* colour; and that *blue* light exists at the *red* extremity, may be proved by the following observation of Sir W. Herschel.[1] He had occasion to view the prismatic spectrum, when reflected from clear turned brass, and he observes, "The colour of the brass *makes the red rays appear like orange*, and *the orange colour is likewise different from what it ought to be*." Here then, yellow light was seen at the very red end of this spectrum, and it was seen in consequence of *blue* light having been absorbed by the brass, because *blue* light mixed with the *orange*, observed by Sir W. Herschel, would alone recompose the original red. Here, then, there is a proof that *blue* light, and *yellow* light, and *red* light, all exist in the same place, at the least refrangible end of the spectrum. Effects similar to these may be produced by various coloured media, such as chemical solutions, or the coloured juices of plants; and by such means Sir David Brewster has succeeded *in insulating white light in the spectrum, incapable of being decomposed by the prism*. In a more recent memoir, "On the connexion between the phenomena of the absorption of light and those of thin plates,"[2] he has shewn that a separation of rays of different colours but equal refrangibility, is effected by the continued production of periodical colours by a number of thin plates acting successively upon the same pencil.

The existence of fixed lines in the spectrum, as discovered by Fraunhofer, was a fact unexampled in science. Various coloured bodies were known to absorb particular parts of the spectrum, and their peculiar colour was the necessary consequence of this absorption. Some of them, such as smalt blue glass, produced at a certain thickness several dark bands in the spectrum, but these bands shaded off by

[1] *Phil. Trans.* 1800, vol. xc. p. 255.

[2] *Id. Id.* 1837.

ismatic
ectrum.

imperceptible degrees, and had no definite boundary.[1] In examining the action of all the coloured solid and fluid bodies which he could command, Sir David Brewster was led to observe the action of nitrous acid gas on the spectrum.[2]

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trum.

With a fine prism of rock salt, having the largest possible refracting angle, he formed a spectrum with the light of a lamp transmitted through a small thickness of the gas, whose colour was a very pale straw yellow, and he was surprised to observe the spectrum crossed with hundreds of lines or bands, much more distinctly pronounced than those of the solar spectrum. In the violet and blue spaces the lines were sharpest and darkest; they were fainter in the green, and almost imperceptible in the yellow and red spaces. By an increase in the thickness of the gas, the lines were better developed in the yellow and red spaces, and became broader in the blue and violet, a general absorption or extinction of the light advancing from the violet extremity, while a specific absorption was going on, on each scale of the lines or bands. It was not easy to obtain a sufficient thickness of gas to bring out the lines at the red extremity, but our author found that heat produced the same effect as an increase of thickness, and by greatly heating a tube half an inch wide, and full of gas, he was able to exhibit the lines and bands to the very extremity of the red space.

"The power of heat alone," says our author, "to render a gas which is almost colourless as red as blood, without decomposing it, is in itself a most singular result, and my surprise was greatly increased when I afterwards succeeded in rendering the same pale nitrous acid gas so absolutely black by heat, that not a ray of the brightest summer's sun was capable of penetrating it. In making this experiment the tubes frequently exploded, but by using a mask of mica and thick gloves, and placing the tubes in cylinders of tinned iron, with narrow slits to admit the light, there is little danger of any serious accident."

It is a remarkable fact that the liquified gas in the very same tube, produces none of the fixed lines, and exercises no other action on the spectrum than any ordinary fluid of the same orange colour.

As the points of maximum absorption in coloured bodies were distinctly coincident with some of the principal lines in the solar spectrum, our author suspected that the same might be true with regard to the nitrous gas lines, and he therefore formed the solar and the gaseous spectrum with light passing through the same aperture, so that the lines in the one stood opposite to those in the other, aud their coincidence became a matter of simple observation. He then superimposed the two spectra, when both were formed by solar light, and thus exhibited at once the two series of lines and bands, with all their coincidences and deviations. This phenomenon is one of the most splendid in physical optics.

"The general coincidence," continues our author, "thus cognizable by the eye, requires to be more particularly explained. Though some of the larger lines in the gaseous spectrum coincide with some of the larger ones in the solar spectrum, yet, in many cases, faint and narrow lines in the one coincided with strong and broad lines in the other; and there were some strong gaseous lines, and even broad bands, to which I could discover no counterpart in Fraunhofer's map of the spectrum, which at this stage of my inquiry was the standard to which I appealed. This discrepancy at first embarrassed me, and as I observed it in parts of the spectrum where Fraunhofer had drawn every line which he had seen with his finest instruments, I abandoned all hopes of being able to establish the general principle of their identity. I was therefore obliged either to renounce this principle as one contradicted, or rather not confirmed by observation, or to consider Fraunhofer's delineations as in fault, and to enter upon the Herculean task of making a better map of the spectrum.

Prismatic
Spectrum.

"After a little practice in the observation of the solar spectrum, I discovered most of the lines which I had in vain sought for in Fraunhofer's map, as the counterpart of those in the gaseous spectrum. I saw well marked groups, of which he had only given one of the lines, and shaded bands, and well defined lines, which his method of observation had not permitted him to discover.

New maps
of the solar
spectrum.

"After I had laid down all the principal features in the spectrum, I was able to examine the two classes of lines *pari passu*. The action of the gas upon invisible lines in the spectrum rendered them visible by slightly enlarging them, and this enlargement of a solar line indicated the existence of a corresponding line in the gaseous spectrum.

"By this double process, and by methods of observation which I believe have never before been used in optical researches, I have been able to execute three different maps of the spectrum: *first*, a map of the lines in the solar spectrum; *secondly*, a map of the same spectrum, exhibiting at the same time the action of nitrous acid gas upon solar light, previously deprived of a number of its definite rays; and, *thirdly*, a map shewing the action of the gas upon a continuous and uninterrupted spectrum of artificial white light. The general scale of these delineations is *four* times greater than that of Fraunhofer, but some portions of them are drawn on a scale *twelve* times greater, which became necessary from the impossibility of representing in narrower limits the numerous lines and bands which I have discovered. The length of Fraunhofer's spectrum is $15\frac{1}{2}$ inches; mine, upon the same scale, is nearly 17 inches. The length of the general spectrum, which I have delineated, is about *five* feet eight inches, and the length of a spectrum, corresponding to the scale on which I have delineated parts of it, is *seventeen* feet.

"Fraunhofer has laid down in his map 354 lines, but in the delineations which I have executed, the spectrum is divided into more than 2000 visible and easily recognised portions, separated from each other by lines more or less marked, according as we use the simple solar spectrum, or the solar and gaseous spectra combined, or the gaseous spectrum itself, in which any breadth can be given to the dark spaces."

In this minute examination of the spectrum, our author was led to the discovery of a system of lines and bands, particularly in the red and green spaces, which at other times wholly disappeared; but by a diligent comparison of these observations, he found that these *lines and bands depended on the proximity of the sun to the horizon, and were produced by the absorptive action of the earth's atmosphere.* Sir David Brewster is about to publish his map of the lines of the spectrum, as produced by the light of the sun itself, and another map of the spectrum, as modified by the action of the earth's atmosphere. He has, however, made the following general observations on the subject, in reference to the fixed lines of Fraunhofer:—"The atmosphere," he remarks, "acts very powerfully round the line D, and in the space immediately on the least refrangible side of it. It developes a beautiful line in the middle of the double line D, and by enlarging a group of small lines on the red side of D, it creates a band almost as dark as the triple line D itself. It widens generally all the lines, but especially the darkest one, which I call *m*, between C and D. It developes a band on the least refrangible side of *m*, and it acts especially upon several lines, and developes a separate band

[1] A remarkable example of a very definite action on a part of the spectrum was discovered by Sir D. Brewster in the triple oxalate of chromium and potash. It absorbs a very definite band on the least refrangible side of B, a part of the spectrum over which it exercises no general absorptive action. This band lies in the space B*a* of Fraunhofer's map, so that if x is its place, Bx will be $\frac{1}{3}$ B*a*, or its index of refraction in the water spectrum is almost exactly 1·33070·1 —See *Phil. Trans.* 1835, p. 93.

[2] *Phil. Trans.* 1837, part ii. p. 245.—*Edin. Trans.* vol. xii.

Periodical Colours.

on the most refrangible side of C. The lines A, B, and C are greatly widened, and lines and bands are particularly developed between A and B, and generally throughout all the red space.

"Most of the lines thus widened by the atmosphere are faint lines previously existing in the spectrum, and I have no doubt that they would be seen in the spectrum of the lime ball light condensed by a polyzonal lens, and acted upon by thirty miles of atmosphere.

"The absorptive action of the atmosphere shews itself in a less precise manner in the production of dark bands, whose limits are not distinctly defined. A very remarkable narrow one, corresponding to one produced by the nitrous acid gas, is situated on the most refrangible side of C. Another very broad one lies on the most refrangible side of D, close to a sharp and broad band of yellow light, displayed by the general absorption of the corresponding part of the superimposed blue spectrum. There is also an imperfectly defined atmospheric action, corresponding to a group of lines where Dr. Wollaston placed his line C.

"This general description of the atmospheric lines, while it indicates the remarkable fact, that the same absorptive elements which exist in nitrous acid gas, exist also in the atmospheres of the sun and of the earth, leads us to anticipate very interesting results from the examination of the spectra of the planets. Fraunhofer had observed in the spectra of Venus and Mars some of the principal lines of the solar spectrum. This, indeed, is a necessary consequence of their being illuminated by the sun, for no change which the light of that luminary can undergo is capable of replacing the rays which it has lost. But while we must find in the spectra of the planets and their satellites, all the defective lines in the solar spectrum, we may confidently look for others arising from the double transit of the sun's light through the atmospheres which surround them."

PART V. ON PERIODICAL COLOURS.

Periodical colours.

The phenomena of periodical, or recurrent colours, as Dr. Young has very appropriately called them, are among the most interesting in optics, and have been treated of by him with great ability, under our article on CHROMATICS, though not in that popular and descriptive manner, which is required in a work like this. We shall therefore endeavour to give as perspicuous an account as we can of this interesting portion of physical optics.

SECT. I.—*On the Interference of Light.*

Interference of light

The discovery of the interference of light in its simplest form, is due to Grimaldi, as we have already seen. He admitted the sun's light into a dark room, through two small and equal apertures of a circular form. Two cones of diverging light were thus formed, and by receiving them on a screen, held beyond the place where the cones intersected each other, two overlapping luminous circles were seen on the screen. A partially illuminated penumbra surrounded each of these cones, and at the place where the rays from each aperture met, the screen was, generally speaking, more strongly illuminated by the union of the two lights; but the boundaries of the penumbral portions which overlap are much darker than the corresponding portions of the penumbra which do not overlap, as if the one light had at this part put out the other. Upon intercepting the light from one of the apertures, this dark part became brighter, and upon restoring the light it again became darker. The result, therefore, was here unambiguous, and justified the observation of Grimaldi, "that an illuminated surface may be rendered darker by the addition of light."

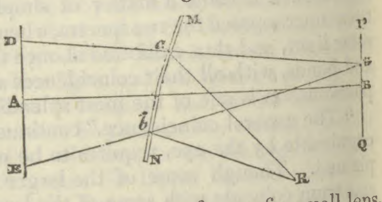
Dr. Hooke made a similar experiment, and observed the darkness produced at the overlapping part of the two cones; but this result, remarkable as it was, seems to have excited no interest during nearly a century and a half, till Dr. Young, who was unacquainted with the experiment of Grimaldi, obtained the same result in a different manner, and thus laid the foundation of the most interesting department of physical optics. The following is the experiment which he gave as "*An Experimental Demonstration of the Interference of Light.*"[1] "I made a small hole in a window shutter, and covered it with a piece of thick paper, which I perforated with a fine needle. For greater convenience of observation I placed a small looking-glass without the window shutter in such a position as to reflect the sun's light in a direction nearly horizontal upon the opposite wall, and to cause the cone of diverging light to pass over a table on which were several little screens of card paper. I brought into a sunbeam a slip of card about $\frac{1}{30}$th of an inch in breadth, and observed its shadow either on the wall, or on other cards held at different distances. Beside the fringe of colour on each side of the shadow, the shadow itself was divided by similar parallel fringes of smaller dimensions, differing in number according to the distance at which the shadow was observed, but leaving the middle of the shadow always white. Now these fringes were the joint effects of the portions of light passing on each side of the slip of card, and inflected or rather diffracted into the shadow. For a little screen being placed either before the card, or a few inches behind it, so as either to throw the edge of its shadow on the margin of the card, or to receive on its own margin the extremity of the shadow of the card, all the fringes which had before been observed in the shadow on the wall, immediately disappeared, although the light inflected on the other side was allowed to retain its course, and although this light must have undergone any modification that the proximity of the other edge of the slip of card might have been capable of occasioning. . . . Nor was it for want of a sufficient intensity of light that one of the two portions was incapable of producing the fringes alone; for when they were both uninterrupted the lines appeared, even if the intensity was reduced to one-tenth or one-twentieth."

Periodical Colours. Dr Young's experiment.

Although this experiment is a very decisive one, yet M. Fresnel made one still more instructive and general, and free from any of the objections that might have been urged against that of Dr. Young. He took two plane mirrors M, N, which were inclined at a very great angle, a little less than 180°, and having allowed a beam of light Ra, Rb, proceeding from a luminous point R such us the focus of a small lens, he received the reflected rays on a piece of paper PQ. If the light was homogeneous, there was seen upon the paper a succession of bright and dark bands alternating. These bands are parallel to the line of intersection of the two mirrors, and they are placed symmetrically on both sides of a plane passing through the line of intersection of the mirrors, and through a point A bisecting the distance of the points D, E, the virtual points of divergence of the two reflected pencils aG, bG. That these parallel bands are produced by the mutual interference of the two beams, is at once proved by intercepting one of them, by covering one of the mirrors, when the whole series disappears. It is found also by measuring distances of the same bands from the line of intersection of the mirrors, and when the paper PQ, is placed at different distances from the mirrors, that their different

Fresnel's experiment.

Fig. 92.



[1] *Phil. Trans.* 1804; or *Elements of Nat. Phil.* vol. ii. p. 639.

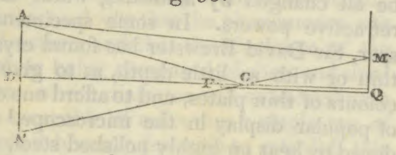
Periodical Colours.

points lie in hyperbolas whose foci are D, E, and common centre A.

Professor Lloyd's experiment.

A still more simple and elegant method of exhibiting the phenomena of interference, has been given by Professor Lloyd of Dublin, which any person may repeat with a single piece of plate glass. Having placed horizontally a piece of black glass QP, with his eye behind it at QM, he viewed by very oblique reflexion, when

Fig. 93.



the angle of incidence was nearly 90°, a horizontal narrow aperture placed at A, a distance of three feet from the reflector QP. The proper degree of obliquity was easily found by bringing the reflected image of the aperture A to coincide very nearly with the direct image, in which case the direction of the reflected plane BPQ, bisected the distance AA′. When the ray AM, which fell directly upon the eye at M, interfered with the reflected rays CM, which reached it by a longer path, they produced a system of fringes or bands, which were distinctly visible when received upon an eye-piece placed at a short distance from the reflector. This system of bands was exactly similar to one-half of the system seen in Fresnel's experiment. With compound white light the first band was a *bright* one and *colourless*. This was followed by a very sharply defined black band; then came a coloured, and so on alternately, seven alternations being easily counted, and the breadth of the bands being, as near as the eye could judge, the same throughout the series, and increasing with the obliquity of the reflected beam. "The first dark band was of *intense blackness*, but the darkness of the succeeding bands were less intense, as they were of higher orders, and after three or four orders they were completely obliterated by the closing in of the bright bands. At the same time the coloration of the bright bands increased with the order of the band, until after six or seven alternations, the colours of different orders became superimposed, and the bands were thus lost in a diffused light of nearly uniform intensity."[1] "These bands," continues Professor Lloyd, "are most perfectly defined when the eye-piece is close to the reflector. Their breadth and coloration increased with the distance of the eye-piece, but remained of a finite and very sensible magnitude, when the latter was brought into actual contact with the edge, a circumstance which distinguished them altogether from the diffracted fringes formed on the boundary of the shadow."

When homogeneous light is used, the bands are alternately bright and dark, and varying in magnitude with the refrangibility of the light, as will be afterwards more fully explained. If the light of the sun is used, the bands may be distinctly seen upon a white screen placed at MQ. That they are produced by interference may be easily proved, either by stopping the direct ray AM, or the reflected ones CM, when the whole system of bands disappears.

The leading phenomena of interference may be likewise exhibited by transmitting the light emanating from a luminous point through the two faces of a prism, the inclination of which is about 180°. The pencil or ray passing through one of the faces, will be slightly inclined to the ray passing through the other, at a small angle, and will interfere with it at their point of concourse, and produce the usual fringes. This form of the experiment is described by Sir Isaac Newton, who considered the fringes as produced by inflexion.

In all the preceding experiments two pencils of light issuing from the same point or luminous origin, are made again to meet, the one having arrived at the point of concourse by a different and a longer path. Now it is obvious from the experiments, that when the two portions of light thus intervening reach the spot where they interfere by paths exactly equal, they form a bright fringe, having the intensity of its light greater than that of either portion. It is also evident that other bright fringes are produced, when their paths differ in length; and if we suppose d to be the difference of paths by which the second bright fringe is produced, similar bright fringes will be produced when the differences in the lengths of the paths are $2d$, $3d$, $4d$, $5d$, $6d$, &c. But it is manifest from the preceding experiments, that if the two portions of light interfere at intermediate points, or when the difference in the length of their paths is $\frac{1}{2}d$; $d+\frac{1}{2}d$; $2d+\frac{1}{2}d$; $3d+\frac{1}{2}d$; $4d+\frac{1}{2}d$, &c. the two interfering portions *destroy each other* and produce blackness, as appears from the dark fringes lying between the bright ones. Here, then, we have a remarkable property of light established by direct experiment, and well fitted to guide us in our inquiries into the physical cause of the various phenomena of light. We shall find the same beautiful property shewing itself under various aspects in a succession of interesting phenomena, which we shall now proceed to describe.

Sect. II.—*On the Colours of Thin Plates.*

Colours of thin plates.

The colours of thin plates were first observed by Mr. Boyle, who remarks that all chemical essential oils, as also good spirits of wine, by shaking till they rise in bubbles, appear of various colours, which immediately vanish when the bubles burst, so that a colourless liquor may be immediately made to exhibit a variety of colours, and lose them in a moment, without any change in its essential principles. Mr. Boyle also noticed these colours in soap bubbles and in turpentine, and he succeeded in blowing glass sufficiently thin to exhibit them. In 1666 Lord Brereton observed similar colours produced by the thin plates which are formed on the surface of glass by the action of the weather. In the year 1672 Dr. Hooke exhibited to the Royal Society a soap bubble with all its colours, in fulfilment of a promise which he had made at a previous meeting, "to exhibit something which had neither refraction nor reflexion, and yet was diaphanous." "By means of a glass pipe he blew several small bubbles out of a mixture of soap and water, when it was observable that at first they appeared white and clear, but that after some time the film growing thinner, there appeared upon it all the colours of the rainbow, first a pale yellow, then orange, red, purple, blue, green, with the same series of colours repeated." Dr. Hooke made considerable progress in the investigation of this class of phenomena, and made experiments with thin plates of Muscovy glass, (Mica). He found that a faint yellow plate of this substance laid upon a blue one constituted a very dark purple; and Sir Isaac Newton, in a private letter to Dr. Hooke, a copy of which is now before us,[2] acknowledges that Hooke had observed previous to him, "the dilatation of the coloured rings by the obliquation of the eye, and the apparition of a black spot at the contact of two convex lenses, and at the top of a water bubble."

Boyle.

Hooke.

Newton.

Sir Isaac Newton, whose investigations we shall presently give in his own words, made great progress in discovering the law of the phenomena, and it is a curious fact not to be overlooked by physical inquirers, that his theory of the phenomena, elaborated with the utmost care and generalising an extensive series of facts, is now exploded, while the theoretical views of Dr. Hooke are almost universally admitted.

Mr. Melville of Edinburgh proposed to make a permanent soap bubble by freezing, but we believe the experiment

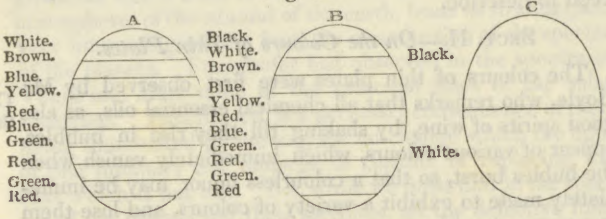
[1] *Transactions of the Royal Irish Academy*, vol. xvii.

[2] Dated Cambridge, February 5, 1675-6.

Dr Reade's permanent soap bubble.

has never yet succeeded. Dr. Joseph Reade has however been more fortunate in making what may be called a permanent soap bubble, for illustrating the colours of thin plates, which we saw him exhibit at the meeting of the Physical Section of the British Association at Liverpool in 1837. The following is his own account of the method of making it: "Having put two ounces of distilled water into an eight-ounce phial, and having added about the size of a large pea of Castile soap, I placed the bottle in a saucepan of boiling water on the fire; the bottle was speedily filled with a dense volume of vapour, which expelled all the air. I now corked it, and after cooling and thus condensing the vapour, had perhaps as perfect a vacuum as could be formed, even by the best air-pump. I now held the bottle laterally between my hands, and by means of a circular and brisk motion formed a circular film, on which by resting the bottle on an inclined plane, were formed after a short time, all the parallel bands or series of colours in the following order: 1. a white or silvery segment at top; 2. a snuff-coloured brown, inclined at bottom to a deep red; 3. blue; 4. yellow; 5. red; 6. blue; 7. green; 8. red; 9. green; 10. red; 11. green. (As in fig. A.)

Fig. 94.



"After some time a black segment was seen to form at the top of the white, and continually to increase in size. (See fig. B.) After a few minutes the parallel bands increased in breadth, and running into one another, only three or four distinct bands were seen. Nothing can exceed the beauty of these colours, equal to those of the rainbow, or the plumage of the tropics: whilst writing this description, I have these bands in a bottle before me, feasting my eyes on their beauty. In a few minutes more this black segment or aqueous film occupies, perhaps, half the circular film, and the lower half becomes white tinged with orange. (See fig. C.)

"If we now incline the bottle towards the experimenter's breast, the saponaceous atoms producing these colours, are seen to float in the region of the black or aqueous; when placed again on the inclined plane, they fall to the bottom of the film. In some time more the entire film becomes black, and all the colours disappear.

"Having now placed the bottle in a basin of boiling water, the evaporation was increased, and the black film soon became clothed with saponaceous atoms, which being variously condensed, produced all the colours of the clouds when the sun is setting on a summer's evening. On again placing the bottle on the inclined plane, the parallel bands were again formed by the attraction of cohesion, and the colours afterwards gave place to the black film. I held the bottle laterally between my hands, and by means of a circular motion washed it, and thus clothed it with saponaceous atoms, which went through the same process on placing the bottle on the inclined plane. By means of washing the film every morning, I preserved it for more than three weeks."

Colours of thin plates exhibited in nature.

The colours of thin plates are often exhibited in nature in the most beautiful manner. On the surface of little pools of mossy water, and especially in the proximity of springs containing iron, we observe thin bright films generally whitish and often yellow and reddish. Between the plates of a mass of mica, and sulphate of lime, and talc, we observe thousands of open spaces where the rings are sometimes circular, consisting only of the first tint above blackness, viz., the white of the first order, sometimes two, three, or more colours according to their size, while at other times the rings or fringes are extremely numerous and often irregular. These colours are all produced by thin plates of air or of vacuity in these fissile minerals, and the colours may be all changed by admitting water or fluids of different refractive powers. In some specimens of Labrador felspar, Sir David Brewster has found crystallised cavities so thin or with so little depth, as to give the most splendid colours of thin plates, and to afford one of the finest subjects of popular display in the microscope.[1] The colours produced by heat on highly polished steel, are all the colours of a thin plate of oxide; and they are often beautifully displayed on the sides and on the bars of grates.

When glass is exposed to the action of the weather, its surface acquires a thin film, which at first can only be rendered visible by examining the faint light reflected from it when it is in contact with a fluid of nearly the same refractive power. It forms most rapidly on the panes of glass in stable windows, but it is seen in the highest perfection in the specimens of decomposed glass found among the remains of Roman buildings. The glass is to a certain depth entirely decomposed into thin films of extreme beauty, reflecting the most brilliant colours to the eye, and transmitting tints of the most exquisite brilliancy, and far surpassing any of the colours produced by art.[2] Coloured films of the richest tints are also seen upon both the faces of cleavage of a sort of artificial mother of pearl, which has been called *nacrite*, and described by Mr. Horner in the *Phil. Trans.*[3] These films are all thin plates of extreme tenuity.

When we breathe upon glass at a proper temperature, and examine with a magnifier the margin of the film while evaporating, or when we observe the evaporation of different volatile fluids, we shall perceive many interesting examples of the colour of thin plates.

One of the finest exhibitions of this kind with which we are acquainted, is that which is produced by the ammonio-sulphate of copper, and which was observed by Sir David Brewster. A solution of the ammonio-sulphate of copper in water, is spread upon a clear plate of glass or any other surface. In the course of an hour or two, a similarly coloured film is formed upon its surface, exhibiting the colours of thin plates from the white of the first order upwards. When the solution is strong, or the stratum of fluid deep, the thickness of the film increases, and the colours rise to higher orders, of a beautiful green and pink colour. When the colours are such as we would wish to preserve, an aperture must be made in the film, and by inclining the plate the fluid must be allowed to run out slowly, leaving the film on the surface of the glass. This film will become hard and permanent after the aqueous part of it has been evaporated. The fringes of colour take the shape of the mass of fluid, or of the piece of glass whose surface is covered with it.

One of the most extraordinary examples of the colours of thin plates, or rather of the blackness that immediately precedes these colours, and one which almost requires the evidence of ocular demonstration to credit, is the existence of filaments, or of a down of quartz so exceedingly minute as to be incapable of reflecting light. The very remarkable specimen of quartz in which this was discovered by Sir David Brewster belongs to the cabinet of the Duchess of Gordon. The original crystal was $2\frac{1}{4}$ inches in diameter, and of a light smoky colour, but impervious to light except in small pieces. Mr. Sanderson, lapidary in Edinburgh, had broken up the crystal for the purposes of his profession, but the apparent foulness of the fracture induced him to lay it aside. The following is an account given by Sir David Brewster, of the principal fracture.

[1] *Edin. Trans.* vol. xi. p. 322. [2] *Phil. Trans.* 1837, part ii. [3] Id. Id. 1836, p. 49, and 1837, part ii.

Periodical Colours.

"At first sight, the absolute blackness of the separated surfaces seemed to me as it did to every one, to be owing to a thin film of opaque and minutely divided matter that had insinuated itself into a fissure of the crystal; but this opinion was immediately overturned when I observed that both surfaces were equally and uniformly black, and that they were also perfectly transparent by transmitted light.

"Although I had now no doubt that the phenomenon was entirely of an optical nature, and that the blackness of the surfaces arose from their being composed of short and slender filaments of quartz, whose diameter was so exceedingly small that they were incapable of reflecting a single ray of the strongest light, yet it became desirable to establish this curious fact by experimental evidence.

"Having found that no detergent substances either removed or diminished the superficial blackness, I subjected the fragment to the action of cold and hot acids; but the surface continued unaltered by these operations. I now immersed the fragment in oil of anise seed, which approaches to quartz in its refractive power, and upon examining the light reflected at the separating surfaces of the oil and the quartz, I found that the blackness disappeared, and that the fragment, whether seen by reflected or transmitted light, comported itself like any other piece of quartz of the same translucency. Upon removing the oil from the surfaces, it resumed its original blackness, and the filamentous or velvety nature of the surface was rendered evident to the eye by the slight change of tint which was produced by pressing the filaments to one side.

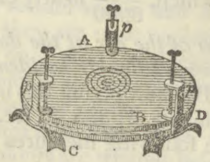
"As the preceding experiments are sufficient to prove that the size of the minute filaments was less than the thickness of a thin plate of quartz which lost the power of reflecting light, it became interesting to obtain an approximate measure of their magnitude. The thinnest substance ever observed, is the aqueous films of the soap bubble previous to its bursting. Newton, however, remarked that the films still reflected a faint image of the candle or of the sun. Hence its thickness must have corresponded nearly with what Newton calls the *beginning of black*, which appears in water at a thickness of the 750,000th part of an inch. The tint, however, of the quartz surface is of a much deeper character, and cannot exceed the *very black* of Newton's scale which corresponds in *quartz* to *one-third of the one-millionth part of an inch*, or to *one-fourth* of the thinnest part of the soap bubble.

"If the two surfaces of quartz had separated by filaments of a larger size, the colour of the filamentous surface might have been *red*, or *blue*, or *yellow*, or *green*; but though such a structure would have been more dazzling to the eye, it yet would have been less wonderful than the one which has now been described."

The colours of thin plates may also be exhibited by pressing together two glass prisms that have moderate refracting angles. Various coloured fringes or portions of coloured rings will be seen by viewing the light reflected from the surfaces in contact, and in a much fainter degree, by examining the transmitted light. The same phenomena may be seen with unusual brilliancy, by taking a thick piece of glass, and having made a scratch on one side of it with a file, apply a heated wire to the scratch, so as to produce a crack in the glass, which may be extended at pleasure by a second and third application of the hot wire. If we now examine the surface of this crack in different directions, we shall see it covered with coloured fringes, which may be made to vary in breadth and position, by opening or closing the crack with the force of the hand.

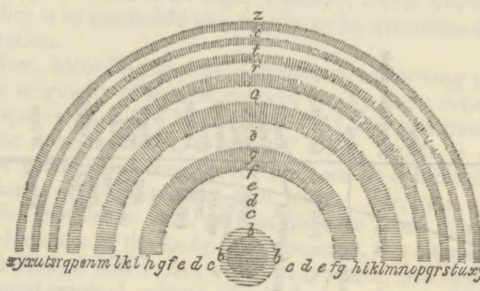
When we wish to examine and measure the coloured rings with care, the method used first by Hooke, and subsequently by Newton, should be adopted. Two convex lenses of very long focal length are placed the one above the other, so as to touch at their vertex; or a plano-convex lens may have its plane side AB laid upon the convex side CD, fig. 97, of another lens. Sir Isaac Newton used for the uppermost lens a plano-convex one, whose focal length was fourteen feet, and for the lowermost a double convex lens, whose focal length was fifty feet. These lenses must then be held together, and pressed if necessary by three clamp screws, as shewn in fig. 95. The following is the general account of the phenomenon given by Sir Isaac Newton, though somewhat abridged:—

Fig. 95.



"Next to the pellucid central spot made by the contact of the glasses, succeeded *blue*, *white*, *yellow*, and *red*. The blue was so little in quantity, that I could not distinguish any violet in it, but the *yellow* and *red* were as copious as the *white*, though four or five times more than the *blue*. The next order of colours round those in the *second*, was *violet*, *blue*, *green*, *yellow*, and *red*, all of them copious and vivid except the green. The *third* order was *purple*, *blue*, *green*, *yellow*, and *red*, the green being more vivid than in the last order. The *fourth* order was only *green* and *red*, the green being copious and lively, being bluish on one side, and yellowish on the other. The red was very imperfect: the succeeding rings or orders of colours were very faint; and after three or four orders, they ended in perfect whiteness. The form of the whole system of rings, when the lenses were most compressed, so as to produce the black spot in the centre, as shewn in fig. 96, where *a, b, c, d, e; f, g, h, i, k;*

Fig. 96.



l, m, n, o, p; q, r; s, t; v, x; y, z, indicate the different colours beginning at the centre, viz. 1. *black, blue, white, yellow, red*; 2. *violet, blue, green, yellow, red*; 3. *purple, blue, green, yellow, red*; 4. *green, red*; 5. *greenish blue, red*; 6. *greenish blue, pale red*; 7. *greenish blue, reddish white*.

In order to find the interval between the glasses, or the thickness of the plate of included air (or space) at which each colour was produced, Sir Isaac measured the diameter of the first six rings at their brightest part, and found their squares to be in the arithmetical progression of the odd numbers 1, 3, 5, 7, 9, &c., and the intervals between the glasses are obviously in the same progression, one of the surfaces being plane, and the other spherical. He then measured the diameter of the rings at their darkest points, and found their squares to be in the arithmetical progression of the even numbers, 2, 4, 6, 8, 10, &c.

In order to find the absolute thickness of the plate of air or space at which these different rings were produced, he measured the diameter of the fifth ring at its darkest point as produced by the different object-glasses.

Diameter of Sphericity of the object-glass.	Diameter of fifth dark ring.
182 inches	$\frac{100}{1774784}$
184 inches	$\frac{5}{88850}$

and dividing these diameters by 5, we obtain the diameter

Periodical Colours.

of the first ring he obtained, $\frac{1}{88739}$ and $\frac{1}{88850}$; but as these measurements were taken at an angle of incidence of 4°, the results must be diminished in the ratio of the seccant of 4°, or 10029, so that we have $\frac{1}{88952}$ and $\frac{1}{89063}$, the mean of which, $\frac{1}{8900}$ nearly expresses in parts of an inch, *the thickness of the air at the darkest part of the first dark ring at a perpendicular incidence.*

By multiplying this interval by the series of odd and even numbers, 1, 3, 5, 7, &c., and 2, 4, 6, and 8, &c., we obtain the following measures of all the rings:—

	Thickness of the air at the brightest part.	Thickness of the air at the darkest part.
First Ring,	$\frac{1}{178000}$	$\frac{2}{178000}$ or $\frac{1}{89000}$
Second Ring,	$\frac{3}{178000}$	$\frac{4}{17800}$ $\frac{2}{89000}$
Third Ring,	$\frac{5}{178000}$	$\frac{6}{17800}$ $\frac{3}{89000}$
Fourth Ring,	$\frac{7}{17800}$	$\frac{8}{17800}$ $\frac{4}{89000}$

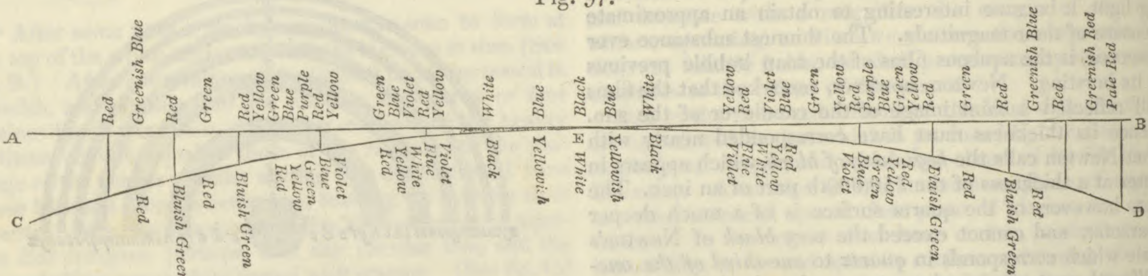
Effects of oblique incidence.

After measuring the diameters of the rings at different angles of incidence, Sir Isaac obtained the following results:

Angle of Incidence on the Air.		Angle of Refraction into the Air.		Diameter of the Ring.	Thickness of the Air.
Degr.	Min.				
00	00	00	00	10	10
06	26	10	00	$10\frac{1}{13}$	$10\frac{2}{13}$
12	45	20	00	$10\frac{1}{3}$	$10\frac{2}{3}$
18	49	30	00	$10\frac{3}{4}$	$11\frac{1}{2}$
24	30	40	00	$11\frac{2}{5}$	13
29	37	50	00	$12\frac{1}{2}$	$15\frac{1}{2}$
33	58	60	00	14	20
35	47	65	00	$15\frac{1}{4}$	$23\frac{1}{4}$
37	19	70	00	$16\frac{1}{5}$	$28\frac{1}{4}$
38	33	75	00	$19\frac{1}{4}$	37
39	27	80	00	$22\frac{6}{9}$	$52\frac{1}{4}$
40	00	85	00	29	$84\frac{1}{13}$
40	11	90	00	35	$122\frac{1}{2}$

From the results given in the preceding table, Sir Isaac Newton has deduced the following rule:—"That the thickness of the air is proportional to the secant of an angle, whose sine is a certain mean proportional between the sines of incidence and refraction; and that mean proportional, so far as, by these measures, I can determine it, is the first of an 106 arithmetical mean proportionals between these sines counted from the higher sine, that is, from the sine of refraction when the refraction is made out of the glass into the plate of air, or from the sine of ineidence when the refraction is made out of the plate of air into the glass."

Fig. 97.



Sir Isaac next proceeds to describe the rings formed by the light transmitted through the two glasses. In this system of transmitted rings, the order of the colours was *yellowish red; black, violet, blue, white, yellow, red; violet, blue, green, yellow, red.* The colours in these rings are very faint at a perpendicular incidence, but become brighter as the incidence increases.

In fig. 97 Sir Isaac has represented the different colours reflected and transmitted, AB and CD being the surfaces of the glasses which touch at E, and the lines uniting them representing their distances in arithmetical progression. The words above the straight line AB are the colours of the *reflected* rings, and those below the circular arch CD those of the transmitted rings.

When water was introduced between the lenses, the colours became fainter, and the rings less, and Sir Isaac found that the intervals were inversely as the indices of refraction in water and air.

The rings were always larger in the homogeneous *red* light of the spectrum than in the *violet* light, in the ratio of $14\frac{1}{2}$ to 9, and he concluded from more detailed observations that the thicknesses of the air between the glasses when the rays were successively formed by the limits of the seven different colours, *red, orange, yellow, green, blue, indigo,* and *violet*, are to one another as the cube roots of the squares of the eight lengths of a cord which sound the notes in an eighth, *sol, la, fa, sol, la, mi, fa, sol,* that is, in the cube roots of the squares of the numbers 1, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{9}{16}$, $\frac{1}{2}$, or 1; 0·924; 0·885; 0·825; 0·763; 0·711; 0·681; 0·630, that is, if 1 be the interior diameter of any such red ring formed by the extreme red rays, the cube root of $\frac{8}{9}$ will be the interior diameter of a ring at the boundary of the red and orange, and so on.[1]

The colours of thin plates of fluid or solid bodies are not so easily studied as those of air, from the difficulty of procuring, and working with, such evanescent films. Sir Isaac Newton, however, studied them in soap bubbles which, as soon as they were blown, he covered with a clear glass. In this way he observed the colours to emerge like so many concentric rings surrounding the summit of the bubble. As the bubble became thinner, and the subsidence and evaporation of the water, the rings dilated slowly, till they covered the whole bubble, descending in order to the bottom of it, till where they vanished successively. After all the colours were emerged at the top, there grew in the centre of the rings a small round black spot, which continually dilated itself till it became sometimes more than a-half or three quarters of an inch in breadth before the bubble broke. Some light was still reflected from the water at this spot, and Sir Isaac saw within it several smaller round spots much blacker and

[1] It has been noticed by M. Le Blanc, that if the two extreme terms of the preceding numbers, or any other two equidistant from th extremes be multiplied together, their product will always be equal to $\frac{1}{2}$

eriodical Colours.

darker than the rest, but still capable, like the larger one, of reflecting faintly an image of the sun.

By observing how much the colours at the same places of the bubble, or at divers places of equal thicknesses, were varied by the several obliquities of the rings, Sir Isaac obtained the following thicknesses of the water requisite to exhibit one and the same colour at several obliquities :—

Incidence on the water.	Refraction into the water.	Thickness of the water.
0°	0° 0′	10
15	11 11	$10\frac{1}{4}$
30	22 1	$10\frac{4}{5}$
45	32 2	$11\frac{4}{5}$
60	40 30	13
75	46 25	$14\frac{1}{2}$
90	48 35	$15\frac{1}{5}$

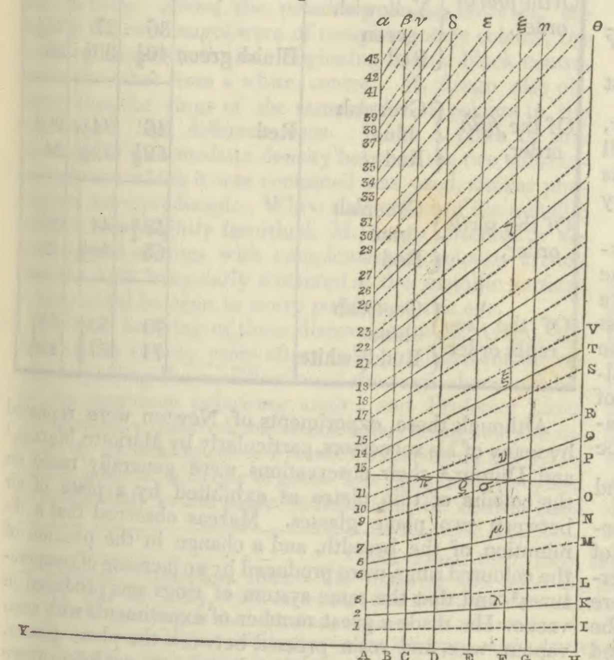
These results harmonise entirely with the rule already given for thin plates of air.

When the system of rings seen by reflection was examined by a prism, and perhaps only eight rings visible, Sir Isaac counted sometimes more than forty on the side of the system to which the refraction was made, though he reckoned by estimation more than a hundred. Soap bubbles also, before they exhibited any colours to the naked eye, have appeared through a prism girded about with many parallel and horizontal rings, to produce which effect it was necessary to hold the prism parallel, or very nearly parallel to the horizon, and to dispose it so that the rings might be refracted upwards.

mposi- of the urs of plates.

Sir Isaac then proceeds to a very important part of the subject, namely, to explain the composition of the colours of thin plates, a topic of great interest and extensive application : "Let there be taken," says he, "on any right line from the point Y, fig. 98, the lengths YA, YB, YC, YD,

Fig. 98.



&c. in the proportion of the numbers, 6300, 6814, 7114, 8255, 8855, 9243, 1000 ; and at the points A, B, C, D, E, F, G, &c. let perpendiculars Aα, Bβ, Cγ, &c. be erected by whose intervals the extent of the several colours set underneath against them is to be represented. Then divide the line Aα in such proportions as the Nos. 1, 2, 3, 5, 7, 9, &c. set at the points of division denote, and through these divisions from Y draw lines 1 L, 2 K, 3 L, 5 M, 6 N.

Periodical Colours.

Now, if A2 be supposed to represent the thickness of any thin transparent body, of which the internal violet is most copiously reflected on the first ring, then HK will represent its thickness, at which the outermost red is most copiously reflected in the same series. Also A 6 and HN will denote the thicknesses at which those extreme colours are most copiously reflected in the second series, and A 10 and HQ the thicknesses at which they are most copiously reflected in the third series, and so on. And the thickness at which any of the intermediate colours are reflected most copiously, will be defined by the distance of the line AH from the intermediate parts of the lines 2 K, 6 N, 10 Q, &c. against which the names of those colours are written below.

But, farther, to define the latitude of these colours in each ring or series, let A 1 be the least thickness and A 3 the greatest thickness, at which the extreme violet in the first series is reflected, and let HI, and HL, be the like limits for the extreme red, and let the intermediate colours be limited by the intermediate parts of the lines 1 I, 3 L, against which the names of those colours are written, and so on. But yet with this caution, that the reflections be supposed strongest at the intermediate spaces, 2 K, 6 N, 10 Q, &c. and from thence to decrease gradually towards these limits, 1 I, 3 L, 5 M, 7 O, &c. on either side ; where you must not conceive them to be precisely limited, but to decay indefinitely. And whereas I have assigned the same latitude to every series ; I did it, because although the colours in the first series seem to be a little broader than the rest, by reason of a stronger reflexion there, yet that inequality is so insensible as scarcely to be determined by observation.

Now, according to this description, conceiving that the rays, originally of several colours, are by turns reflected at the spaces 1 I L 3, 5 M O 7, 9 P R 11, &c. and transmitted at the spaces AHI 1, 3 LM 5, 7 OP 9, &c. it is easy to know what colour must in the open air be exhibited at any thickness of a transparent thin body. For, if a ruler be applied parallel to AH, at that distance from it by which the thickness of the body is represented, the alternate spaces 1 IL 3, 5 MO 7, &c. which it crosseth, will denote the reflected original colours, of which the colour exhibited in the open air is compounded. Thus, if the constitution of the green in the third series of colours be desired, apply the ruler as you see at $\pi\ \rho\ \sigma\ \phi$, and by its passing through some of the blue at π, and yellow at σ, as well as through the green at ρ, you may conclude that the green exhibited at that thickness of the body is principally consituted of original green, but not without a mixture of some blue and yellow.

By this means you may know how the colours from the centre of the outward rings ought to succeed in order as they were described. For, if you move the ruler gradually from AH through all distances, having passed over the first space which denotes little or no reflexion to be made by the thinnest substances, it will first arrive at 1 the violet, and then very quickly at the blue and green, which, together with that violet compound blue, and then at the yellow and red, by whose farther addition that blue is converted into whiteness, which whiteness continues during the transit of the edge of the ruler from I to 3, and after that by the successive deficiency of its component colours, turns first to compound yellow, and then to red, and last of all the red ceaseth at L. Then begin the colours of the second series, which succeed in order during the transit of the edge of the ruler from 5 to O, and are more lively than before, because more expanded and severed. And for the same reason, instead of the former white there intercedes between the blue and yellow a mixture of orange, yellow, green, blue, and indigo, all which together ought

Periodical Colours.

to exhibit a dilute and imperfect green. So the colours of the third series all succeed in order; first, the violet, which a little interferes with the red of the second order, and is thereby inclined to a reddish purple; then the blue and green, which are less mixed with other colours, and consequently more lively than before, especially the green: Then follows the yellow, some of which towards the green is distinct and good, but that part of it towards the succeeding red, as also that red, is mixed with the violet and blue of the fourth series, whereby various degrees of red, very much inclining to purple, are compounded. This violet and blue, which should succeed this red, being mixed with, and hidden in it, there succeeds a green. And this at first is much inclined to blue, but soon becomes a good green, the only unmixed and lively colour in this fourth series. For as it verges towards the yellow, it begins to interfere with the colours of the fifth series, by whose mixture the succeeding yellow and red are very much diluted and made dirty, especially the yellow, which, being the weaker colour, is scarce able to shew itself. After this the several series interfere more and more, and their colours become more and more intermixed, till, after three or four more revolutions, (in which the red and blue predominate by turns) all sorts of colours are in all places pretty equally blended, and compound an even whiteness.

And since the rays endued with one colour are transmitted, where those of another colour are reflected, the reason of the colours made by the transmitted light is from hence evident.

If not only the order and species of these colours, but also the precise thickness of the plate, or thin body at which they are exhibited, be desired in parts of an inch, that may be also obtained by the assistance of the preceding observations. For according to these observations, the thickness of the thinned air, which between two glasses exhibited the most luminous parts of the first six rings were $\frac{1}{178000}$, $\frac{3}{178000}$, $\frac{5}{178000}$, $\frac{7}{178000}$, $\frac{9}{178000}$, $\frac{11}{178000}$ parts of an inch. Suppose the light reflected most copiously at these thicknesses be the bright citrine yellow, or confine of yellow and orange, and these thicknesses will be F λ, F μ, F ξ, F o, F τ. And this being known, it is easy to determine what thickness of air is represented by G ϕ, or by any other distance of the ruler from AH.

But farther, since the thickness of air was to the thickness of water, which between the same glasses exhibited the same colour, as 4 to 3, and the colours of thin bodies are not varied by varying the ambient medium; the thickness of a bubble of water, exhibiting any colour, will be $\frac{3}{4}$ of the thickness of air producing the same colour. And so according to the same observations, the thickness of a plate of glass, whose refraction of the mean refrangible ray, is measured by the proportion of the sines 31 to 20, may be $\frac{20}{31}$ of the thickness of air producing the same colours; and the like of other mediums. I do not affirm that this proportion of 20 to 31 holds in all the rays; for the sines of other sorts of rays have other proportions. But the differences of these proportions are so little that I do not here consider them. On these grounds I have composed the following table, wherein the thickness of air, water, and glass, at which each colour is most intense and specific, is expressed in parts of an inch divided into ten hundred thousand equal parts.

The Thickness of Coloured Plates and Particles of Air, Water, and Glass.

	Reflected Tints.	Transmitted Tints.	Air.	Water.	Glass.
Their colours of the *first* order.	Very black		$\frac{1}{2}$	$\frac{3}{8}$	$\frac{10}{31}$
	Black	White	1	$\frac{3}{4}$	$\frac{20}{31}$
	Beginning of black		2	$1\frac{1}{2}$	$1\frac{2}{7}$
	Blue	Yellowish red	$2\frac{2}{5}$	$1\frac{4}{5}$	$1\frac{11}{20}$
	White	Black	$5\frac{1}{4}$	$3\frac{7}{8}$	$3\frac{2}{5}$
	Yellow	Violet	$7\frac{1}{2}$	$5\frac{1}{3}$	$4\frac{3}{5}$
	Orange		8	6	$5\frac{1}{6}$
	Red	Blue	9	$6\frac{3}{4}$	$5\frac{4}{5}$
Of the *second* order,	Violet	White	$11\frac{1}{6}$	$3\frac{3}{8}$	$7\frac{1}{5}$
	Indigo		$12\frac{5}{6}$	$9\frac{5}{8}$	$8\frac{2}{11}$
	Blue	Yellow	14	$10\frac{1}{2}$	9
	Green	Red	$15\frac{1}{8}$	$11\frac{1}{3}$	$9\frac{5}{7}$
	Yellow	Violet	$16\frac{2}{7}$	$12\frac{1}{5}$	$10\frac{2}{5}$
	Orange		$17\frac{2}{9}$	13	$11\frac{1}{9}$
	Bright red	Blue	$18\frac{1}{5}$	$13\frac{3}{4}$	$11\frac{5}{6}$
	Scarlet		$19\frac{2}{3}$	$14\frac{3}{4}$	$12\frac{2}{3}$
Of the third order,	Purple	Green	21	$15\frac{3}{4}$	$13\frac{11}{20}$
	Indigo		$22\frac{1}{40}$	$16\frac{4}{7}$	$14\frac{1}{4}$
	Blue	Yellow	$23\frac{2}{5}$	$17\frac{11}{20}$	$15\frac{1}{10}$
	Green	Red	$25\frac{1}{6}$	$18\frac{6}{10}$	$16\frac{1}{4}$
	Yellow		$27\frac{1}{7}$	$30\frac{1}{3}$	$17\frac{1}{2}$
	Red	Bluish green	29	$21\frac{3}{4}$	$18\frac{5}{7}$
	Bluish red		32	24	$20\frac{2}{3}$
Of the *fourth* order,	Bluish green		24	$25\frac{1}{2}$	22
	Green	Red	$35\frac{2}{7}$	$26\frac{1}{2}$	$22\frac{3}{4}$
	Yellowish green		36	27	$23\frac{2}{9}$
	Red	Bluish green	$40\frac{1}{3}$	$30\frac{1}{4}$	26
Of the *fifth* order,	Greenish blue	Red	46	$34\frac{1}{2}$	$29\frac{2}{3}$
	Red		$52\frac{1}{2}$	$39\frac{3}{8}$	34
Of the *sixth* order,	Greenish blue		$58\frac{3}{4}$	44	38
	Red		65	$48\frac{3}{4}$	42
Of the *seventh* order	Greenish blue		71	$53\frac{1}{4}$	$45\frac{4}{5}$
	Ruddy white		71	$57\frac{3}{4}$	$49\frac{2}{3}$

Although these experiments of Newton were repeated by many of his successors, particularly by Mariotte, Mazeas,[1] and Dutour,[2] their observations were generally made on the colours of thin plates as exhibited by a plate of air between two plane glasses. Mazeas observed that a diminution of the breadth, and a change in the position of the coloured rings, were produced by an increase of temperature;[3] and that the same system of rings was produced in vacuo. He made a great number of experiments with suet, vapour, wax, and rosin pressed between the plane glasses, but he was perplexed with the phenomena, not being aware that he was actually making experiments with mixed plates in which the colours follow an entirely different law. M.

[1] *Mem. Acad. Berlin*, 1752, *and Memoires Presentées*, tom. ii. p. 28.
[2] *Memoires Presentées*, tom. iv. p. 724.
[3] He made the lenses almost red hot, and by pressing them with a rod of iron, he saw the rings produced as before.

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Dutour and Sir William Herschel observed the reflected and the transmitted tints at the same time, the last series being reflected to the eye by the lower surface of the glass, and M. Dutour observed these reflected ones more distinctly by making the shadow of an opaque body pass over the upper surface. Sir W. Herschel observed additional sets of rings by increasing the number of reflecting faces; and in producing the primary reflected system by a lens pressed against a metallic reflector, he remarks that the transmitted system must in this case be conceived to have been absorbed by the metallic surface.[1]

Arago.

In an interesting paper on the colours of thin plates published in the *Mémoires D'Arcueil*,[2] M. Arago has given an account of some important discoveries on this subject. In viewing the reflected rings through a rhomb of Iceland spar, having its principal section parallel or perpendicular to the plane of incidence, he observed, that the intensity of light in one of the images, varied with the angle of incidence, and that this image vanished at an incidence of 35° the maximum polarising angle for glass. He discovered the very same property in the transmitted rings. This eminent philosopher has also shewn, that when the reflected and the transmitted systems of rings are superposed, they completely neutralise each other, forming white light; and hence he concluded, that their colours were complementary, and the intensities of their illumination exactly the same.

M. Arago next examined the system of rings when formed between a lens and a metallic reflector. When he observed them with the rhomb of spar above mentioned, one of the images vanished as formerly at 35° of incidence, the *angle of maximum polarisation of glass;* but *above* and *below* that angle M. Arago observed the most singular phenomena. At incidences *below* 35°, the two images formed by the doubly refracting rhomb differed only in intensity, the colours and the diameters of the rings being exactly the same in both. *Above* the polarising angle, however, the rings in the two images were of complementary colours, the orders of colours in the one beginning from a black centre, and in the other from a white centre. M. Arago also observed that the rings of the same order of colours in the two images had different sizes. When a plate of any substance of intermediate density between the two substances between which it was contained was used, similar phenomena were produced. When the surface of the metallic reflector was slightly tarnished, M. Arago observed a second system of rings with complementary colours, arising from the light irregularly scattered at the metallic surface, as they could be seen in every position of the eye.

Mr. Airy.

Without knowing of these discoveries of M. Arago, Mr. Airy,[3] about twenty years afterwards, published similar results respecting the modification of the rings above and below the maximum polarising angle; and Professor Lloyd has ingeniously observed, that an analogous result "may be obtained by combining (as in Fresnel's experiment, fig. 92,) a metallic reflector with one of glass. The light being polarised perpendicularly to the plane of reflexion, the central band will be white, when the angle of incidence is below the polarising angle of the glass; at the polarising angle, the interference bars will vanish altogether; and beyond that incidence they will reappear with a *dark* centre in place of a white one. This method of observation would seem to be peculiarly adapted to the investigation of the change of phase produced by metallic reflexion at various incidences."[1]

Professor Lloyd.

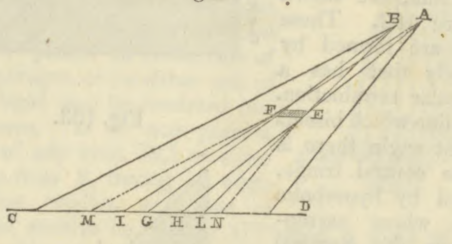
A consideration of Fresnel's expressions, which had led Mr. Airy to make his experiments with a metallic surface, led him also to expect that when the rings were formed between two transparent surfaces of different refractive powers, and when the light was polarised perpendicularly to the plane of incidence, the rings should be *black centred* at incidences below the maximum polarising angle of the least refractive surface, or greater than that of the highest refractive surface, and should be *white*-centred, when the angle of incidence was between these angles. By forming the rings between plate glass and diamond, Mr. Airy found his anticipations correct. In the course of these experiments Mr. Airy observed that the rings did not disappear at the polarising angle of diamond, but that the first black ring contracted as the incidence was gradually increased, and at last took the place of the central white spot. Hence he concluded that there is still some light reflected at the maximum polarising angle of diamond, and that this body has no angle of complete polarisation. See page 376, col. 2.

SECT. III.—*On the Diffraction or Inflexion of Light.*

Diffraction of light.

M. Grimaldi, to whom we owe the discovery of the interference of light, likewise made some important experiments on what is called the diffraction or inflexion of light. Having admitted a ray of solar light into a dark room, through a small hole AB, he placed in the conical beam ABCD an

Fig. 99.



Fringes without the shadow.

opaque body EF. The shadow of this body was not bounded by the straight lines AEH, BFG, nor by the penumbra IL formed by the lines BEI, AFL, but was enlarged to MN, and was much greater than it should have been, if formed by rays passing in straight lines past the edges of the body. Without the shadow of the body there were three fringes of coloured light, the broadest and most luminous of which, next to the shadow X, fig. 100, was MNO. There was no colour in the middle at M, but it was *blue* at the side NN, and *red* at the other side OO. The second fringe

[1] *Phil. Trans.* 1807, 1809, 1810.

[2] Tom. iii.

[3] *Cambridge Transactions*, 1832.—The following note upon this paper we confess ourselves unable to understand, "I have carefully verified," says Mr. Airy, "this assertion, (that it is indifferent whether the light is polarised before or after reflexion) because I think that it leads to important theoretical conclusions. If polarisation were a *modification* of light (as Dr. Brewster and others have supposed,) it might be conceived that polarisation before incidence, might destroy its power of producing rings at a certain angle, or might change the tints; but when the reflexion is performed, and the rings are actually visible to the eye with a dark centre, it seems quite inconceivable that any *modification* or *physical change* in the light should make that centre appear white. The satisfactory explanation is, that polarisation is a *resolution* of the vibrations into two sets at right angles to each other, performed in such a manner that the two sets can in general be separately exhibited, and that in this instance only one is transmitted to the eye." The authors criticised in the preceding extract, viz. Malus, Young, Biot, Herschel, and we believe MM. Arago and Fresnel, all considered polarisation as a modification of common light, and if a *modification* certainly a *physical change* without any reference to theory. In every point of view, indeed, the term is philosophical and unexceptionable. If polarisation is a *resolution*, as Mr. Airy affirms, of vibrations *in an infinite number of planes*, into *two sets at right angles to each other*, which we do not question, this is certainly a pretty considerable modification and a very remarkable physical change. As we have nothing to do with theories in describing phenomena, we must continue to use the terms which have been regarded as appropriate by our contemporaries.

[4] *Report on Optics*, British Association Reports, *Rep.* 4, 1835, p. 366.

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QPR was narrower than MNO. It was colourless in the

Fig. 100.

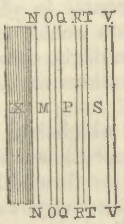
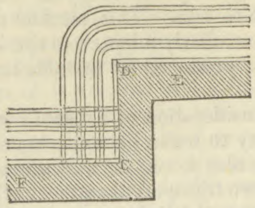


Fig. 101.

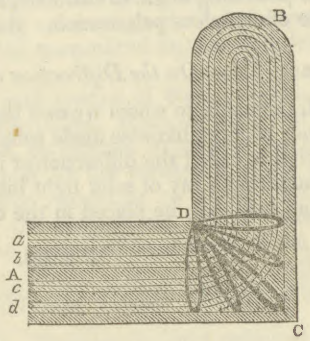


middle at P, faintly blue at QQ, and faintly red at RR. The third fringe STV resembled the other two, but was the narrowest and the faintest in its colours. They were bent round the edges of the body, as shewn in fig. 101.

Fringes within the shadow.

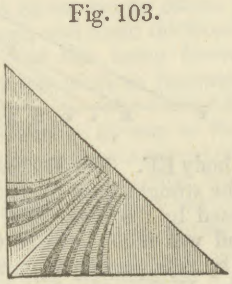
Grimaldi likewise discovered fringes within the shadow, which were best seen when the body was long, the light great, and its distance from the aperture considerable. These internal fringes increased with the breadth of the body, and they became narrower when they increased in number. They were bent round the angles of the body, as shewn in fig. 102, where ADBC is the shadow, and *a*, *b*, *c*, *d* the internal fringes. Short lucid streaks were seen proceeding, as it were, from the angle D, and returning to it, as shewn in the figure.

Fig. 102.



What Dr. Young has called the *crested fringes* of Grimaldi, are shewn in figure 103. These fringes are formed by any body that has a rectangular termination. At the line which bisects the right angle there is a white central fringe, bounded by hyperbolic curves, whose asymptotes are the diagonal line, and on each side of this are two or three other bands, disposed in hyperbolic curves, which are convex to the diagonal, and converging in some degree, as they recede from the angular point.

Fig. 103.



Sir Isaac Newton.

In repeating the experiments of Grimaldi, Sir Isaac Newton admitted the sun's light through a small hole in a piece of lead the forty-second part of an inch in diameter; he found the breadth of the shadow of a human hair, which was the 280th of an inch in diameter, to be as follows:—

Distance of the hair from the aperture.	Distance of the paper receiving the shadow from the hair.	Breadth of the shadow.
12 feet............	4 inches	0·01666 inches.
12 —	24 —	0·03572 —
12 —	128 —	0·125 —

Upon comparing the breadths of the fringes without the shadow, and their intervals at different distances, he found them to be nearly in the same proportion, the breadths of the fringes being as the numbers 1, $\sqrt{\frac{1}{3}}$, $\sqrt{\frac{1}{5}}$, &c., and their intervals to be in the same progression. Hence the fringes and their intervals together was as the number 1, $\sqrt{\frac{1}{2}}$, $\sqrt{\frac{1}{3}}$, $\sqrt{\frac{1}{4}}$, &c.

When the hair was surrounded with water, the very same phenomena were seen, and metals, stones, glass, wood, horn, ice, &c., produced the very same fringes. The following was the order of the colours, reckoning from the shadow:—

First fringe,....Violet, indigo, pale blue, green, yellow, red.
Second fringe,..Blue, yellow, red.
Third fringe,...Pale blue, pale yellow, red.

Fringes in homogeneous light.

When homogeneous light was used, Sir Isaac found that the fringes were *largest* in *red* light, *least* in *violet* light, and of an intermediate size in *green* light. In one case, the distance between the middle of the first fringe on each side of the shadow was $\frac{1}{37\cdot5}$ of an inch in *red* light, and $\frac{1}{46}$ in *violet* light.

Knife edges.

From experiments made by Sir Isaac Newton on the light which passed by the edge of a knife, and on that which passed between two knife edges parallel to each other, he concluded that the light of the *first* fringe passed by the edge of the knife at a distance greater than the 100th part of an inch; the light of the *second* at a greater distance than that of the first; and the light of the *third* fringe at a greater distance than that of the second.

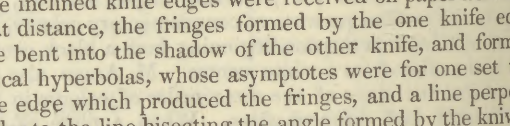
Sir Isaac then stuck into a board the points of two knives with straight edges, so that their edges formed an angle of 1° 47′ 26″, and from the observations which he made on the light which passed between them, he concluded *that the light which forms the fringes is not the same light at all distances of the paper from the knives*, obviously considering each fringe as produced like caustic curves, by the intersection of the inflected rays. When the fringes formed by these inclined knife edges were received on paper held at a great distance, the fringes formed by the one knife edge were bent into the shadow of the other knife, and formed cubical hyperbolas, whose asymptotes were for one set the knife edge which produced the fringes, and a line perpendicular to the line bisecting the angle formed by the knives.

Dr. Thomas Young.

Although many attempts were made during the last century to complete the unfinished labours of Newton on this subject, yet no decided discovery was made till the time of Dr. Thomas Young. This distinguished natural philosopher, in endeavouring to explain the origin of the fringes which surrounded the shadow of the margin of a small circular aperture, conceived that the light nearest its centre was least inflected, and that nearest its edges most; and that another portion of light reflected from the margin of the aperture, and coinciding either exactly or nearly with the direct light, after a circuitous path, would interfere with that light, and produce colour. In November 1803 he confirmed this supposition to a certain extent, in so far as the production of the colours by interference was concerned, by his discovery of the interference of light, as already described.

The fringes formed by inflexion, as observed by Dr. Young, are shewn in fig. 104, where ABCD is the shadow of the

Fig. 104.



inflecting body with its *internal fringes*, which he considered as produced by the light passing on each side of the inflecting body, and bent into the shadow, so as to interfere in the manner already described. This he clearly proved to odical ours.

be the case; but he was less successful in explaining the external fringes between AC and GH, and between BD and EF. He ascribed them to the interference of rays *reflected from the margin* of the inflecting body, with rays which passed by it directly.

Dr. Young examined the *crested fringes* of Grimaldi in the same manner as he did the internal fringes ABCD. He found that when a screen was placed within a few inches of the inflecting angle of the body, so as to receive only one of the edges of the shadow, all the crested fringes disappeared; but if the rectangular point of the screen was opposed to the point of the shadow, so as barely to receive the angle of the shadow, or its extremity, the fringes were in no way affected.

Fresnel

M. Fresnel in France, and M. Fraunhofer at Munich, were simultaneously occupied in studying the inflexion of light, and each of them published the results of their labours, without any knowledge apparently that the other had been similarly occupied. We shall begin by giving an account of Fresnel's experiments.

In place of a small hole, M. Fresnel adopted the ingenious idea of substituting a lens of short focal length, which collected the solar rays into its focus, from which they diverged as from a small luminous aperture. When bodies were placed in this bright light, they gave distinct fringes, the magnitude of which he was able to measure at various distances behind the inflecting body, and at various distances of the inflecting body from the lens, simply by viewing the fringes with an eye-glass furnished with a micrometer, instead of rendering them dull by receiving them upon paper. In this manner he measured their breadths within the one or two-hundredth part of a millimeter. He traced the external fringes up to their very origin, and by the aid of a lens of a short focus, he saw the *third* fringe at the distance of less than the one-hundredth part of a millimeter from the edge of the inflecting body. M. Fresnel made also the important discovery that the phenomena varied with the distance of the inflecting body from the radiating or luminous point, as will be seen from the following measures:—

Distance of the inflecting body from the focus of the lens.	Distance behind the body where the inflexion was measured.	Angular inflexion of the red rays of the first fringe.
0 feet 4 inches..........	3.281 feet..............	12′ 6″
19 — ·48 —	3·281 —	3 55

from which it appears that the rays experience a less degree of inflexion in proportion to the distance of the inflecting body from the radiant point.

When the inflecting body was kept at a fixed distance from the lens, M. Fresnel measured the inflexion of the same fringe at different distances behind the inflecting body, and the result of these measurements was, *that the successive positions of the same fringe did not lie in a straight line, but formed a curve, whose concavity is turned towards the inflecting body.* The successive positions of the same fringe in all the orders of colours he found to be hyperbolas, having the radiating point and the edge of the inflecting body for their common foci. In some of these curves the maximum deviation from a straight line was the twenty-fifth part of an inch, or nearly fifty times greater than the error of observation.

In explaining the exterior fringes, M. Fresnel agreed with Dr. Young in supposing that rays reflected from the margin of the inflecting body interfered with the direct rays; but he was afterwards led, both by theory and experiment, to renounce this opinion.

He found that the fringes were absolutely independent of the curvature of the margin of the inflecting body, and that in cases where the margin was made extremely narrow or sharp, the small quantity of light which it could reflect would be incapable of producing, by its interference with the direct light, such bright fringes as are actually observed. To assure himself of this, he took two plates of steel, the edge of each of which was rounded in one half of its length, and sharp in the remaining half; he placed the rounded portion of one edge opposite the sharp portion of the other, and *vice versa*. Hence, if the position of the fringes depended on the form of the surface, the effect would thus be doubled, and the fringes appear broken in the middle. They were on the contrary perfectly straight throughout their whole length.[1] M. Fresnel was therefore obliged to suppose, and the supposition he found to be perfectly conformable to the undulatory theory, that rays that pass at a sensible distance deviate from their primitive direction, and interfere with those which pass directly by the edge of the body.

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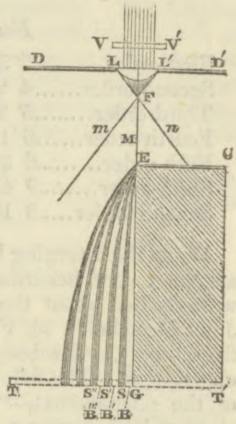
In order to settle this question, M. Fresnel compared the results of Dr. Young's hypothesis with those of his own, and he found that the breadth of any fringe of homogeneous light should be on the two hypotheses as 2 to 1·8726, and having measured the diameter of such a fringe, he found his own hypothesis more consistent with observation than Dr. Young's.

Fig. 105.



In order to exhibit to the eye the hyperbolic form of the fringes, we have given a representation of them in fig. A, where LL is a lens of short focus, by which the rays of the sun entering a dark chamber, are refracted to a focus F, from which they again diverge, forming the cone F*mn*. Or the lens may be fixed in a large diaphragm DD′, which may stand on the table before the window at which the sun's light enters. By means of a coloured glass VV′ placed on either side of the diaphragm, or on either side of F, the light may be rendered homogeneous. If we now place a screen of any kind, EC, at some distance from F, having its edge somewhat smaller, and free of dust, and receive its shadow GT′ upon a sheet of paper, or any white ground, TT′, or on a glass plate roughened with emery, we shall obtain the section of the fringes formed by diffraction. The line FEG, which is the geometrical shadow, is not the real shadow. On the side of it towards GT′, the paper will not appear *black*, but illuminated with a visible shade, which goes on decreasing nearly uniformly for a considerable distance. On the other side of EG there are several fringes or alternations of light and darkness. The *first* fringe B parallel to the shadow is *bright*, then a band S almost entirely black, which is the *black fringe* of the *first order*, then a second *bright* fringe B′, which is followed by the *second black fringe* S′. These alternations continue to a great distance from G, so that even the sixteenth or seventeenth order may be observed, the bright fringes becoming less coloured, and the black ones more luminous, till they are no longer visible.

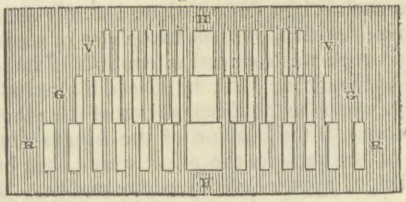
By varying the distance of the paper TT′ from the screen EC, or of the screen from the focus F, the same fringes are produced with certain variations depending on their distances, the fringes being propagated in hyperbolas, as shewn in the figure. The fringes are *largest* in *red* R, smallest in *violet* V, and of an intermediate size in *green* light G, as re-

[1] *Mémoire sur la Diffraction*, p. 370. Prof. Lloyd's Report, *ut antea*.

Periodical Colours.

presented in fig. 106, where they are shewn as on each side of the shadow of a human hair HH.

Fig. 106.



The following table shews the angular distances of the seven first fringes from the inflecting body EC, and the geometrical shadow :—

For Red Light.

	Angles, FE = 1000 millimetres.	Angles, FE = 100 millimetres.	Angles, FE = 10 millimetres.
First order	3′ 35″	11′ 20″	35′ 51″
Second order	5 15	16 35	52 25
Third order	6 30	20 32	1° 4 56
Fourth order	7 32	23 50	1 15 21
Fifth order	8 27	26 44	1 24 31
Sixth order	9 17	29 20	1 32 44
Seventh order	10 3	31 45	1 41 21

For Violet Light.

First order	2′ 58″	9′ 22″	29′ 36″
Second order	4 20	13 42	43 18
Third order	5 21	16 55	53 36
Fourth order	6 13	19 40	1° 2 15
Fifth order	6 59	22 5	1 9 48
Sixth order	7 40	24 15	1 16 38
Seventh order	8 18	26 14	1 22 53

Sir John Herschel.

When the diverging light passes through a small circular aperture, very beautiful phenomena are observed, which were studied about the same time by M. Fresnel and Sir John Herschel.[1] M. Fresnel had deduced the phenomena from theory, and subsequently confirmed his deductions by experiment. The following is Sir John Herschel's[2] account of the phenomena:—"Suppose," says he, "we place a sheet of lead, having a small pin-hole pierced through it, in the diverging cone of rays from the image of the sun, formed by a lens of short focus, and in the line joining the centres of the hole and focus prolonged, place a convex lens or eye-glass, behind which the eye is applied. The image of the hole will be seen through the lens as a brilliant spot, encircled by rings of colours of great vividness, which contract and dilate, and undergo a singular and beautiful alternation of tints, as the distance of the hole from the luminous point, on the one hand, or on the eye-glass, on the other, is changed. When the latter distance is considerable, the central spot is white, and the rings follow nearly the order of the colours of thin plates. Thus, when the diameter of the hole was about 1-30th of an inch, its distance (a) from the luminous point about six feet six inches, and its distance (b) from the eye-lens twenty-four inches, the series of colours was observed to be,

"1st order. White, pale yellow, yellow, orange, dull red.

"2d order. Violet, blue (broad and pure), whitish, greenish yellow, fine yellow, orange red, very full and brilliant.

"3d order. Purple, indigo blue, greenish blue, pure brilliant green, yellow green, red.

"4th order. Good green, but rather sombre and bluish, bluish white, red.

"5th order. Dull green, faint bluish white, faint red.

"6th order. Very faint green, very faint red.

"7th order. A trace of green and red.

"When the eye-lens and hole are brought nearer together, the central white spot contracts into a point and vanishes, and the rings gradually close in upon it in succession, so that the centre assumes in succession the most surprisingly vivid and intense hues. Meanwhile the rings surrounding it undergo great and abrupt changes in their tints. The following were the tints observed in an experiment made some years ago, (July 12, 1819), the distance between the eye-glass and luminous point ($a+b$) remaining constant, and the hole being gradually brought nearer to the former :—

$b=$	Colour of the central Spot.	Surrounded by
24·00	White.	Rings as in the foregoing description.
18·00	White.	The two first rings confused, the red of the 3d, and green of the 4th orders splendid.
13·50	Yellow.	Interior rings much diluted, the 4th and 5th greens, and 3d, 4th, and 5th reds, the purest colours.
10·00	Very intense orange.	All the rings are now much diluted.
9·25	Deep orange red.	The rings all very dilute.
9·10	Brilliant blood red.	The rings all very dilute.
8·75	Deep crimson red.	The rings all very dilute.
8·36	Deep purple.	The rings all very dilute.
8·00	Very sombre violet.	A broad yellow ring.
7·75	Intense indigo blue.	A pale yellow ring.
7·00	Pure deep blue.	A rich yellow.
6·63	Sky blue.	A ring of orange, from which it is separated by a narrow sombre space.
6·00	Bluish white.	Orange red, then a broad space of pale yellow, after which the other rings are scarcely visible.
5·85	Very pale blue.	A crimson red ring.
5·50	Greenish white.	Purple, beyond which yellow, verging to orange.
5·00	Yellow.	Blue, orange.
4·75	Orange yellow.	Bright blue, orange red, pale yellow, white.
4·50	Scarlet.	Pale yellow, violet, pale yellow, white.
4·00	Red.	White, indigo, dull orange, white.
3·85	Blue.	White, yellow, blue, dull red.
3·50	Dark blue.	Orange, light blue, violet, dull orange.

"The series of tints exhibited by the central spot is evidently, so far as it goes, that of the reflected rings in the colours of thin plates; the surrounding colours are very capricious, and appear subject to no law."

We owe also to Sir John Herschel the following beautiful experiment with two equal apertures placed near each other. The rings are formed about each as in the case of

[1] Sir John Herschel's experiment was made on the 12th July 1819, but was not published till 1825.

[2] *Treatise on Light*, sect. 729, 730.

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one aperture, but these are accompanied with a set of straight parallel fringes, bisecting the interval between their centres, and perpendicular to the line joining their centres. Two other sets of similar fringes appear in the form of a St. Andrew's cross, forming equal angles with the first set, as shewn in Plate CCCLXXXI. fig. 5. When the apertures are unequal, as in fig. 6, these fringes assume the form of hyperbolas, having the aperture in their common focus. By varying the number and shape of the apertures, the phenomena became exceedingly beautiful.

late CCLXXXI. igs. 5, 6.

I. Poisson

M. Poisson deduced from theory that the centre of the shadow of a small circular opaque disc, exposed to light emanating from a single luminous point, would be precisely as much illuminated by the diffracted light as it would be by the direct light, if the disc were removed. By using a small disc of metal, cemented to a clear and homogeneous plate of glass, M. Arago confirmed this very remarkable result.

I. Arago.

We owe to M. Arago a series of beautiful discoveries respecting the influence of transparent screens in the phenomena of inflexion. When a thick piece of glass was used as a screen on one side of the inflecting body, the rings wholly disappear, as if the screen were opaque. If the screen is very thin, like a film of sulphate of lime or mica, the fringes still remain visible, but shift their places, and are moved from the side where the screen is interposed.

If we make this experiment on the fringes produced by two apertures, we have only to cover one of the apertures with the screen. The same effect, however, will be produced, if we cover both apertures with screens of different thicknesses. In this case the fringes will shift their places from the thicker plate, without suffering any other change.

This beautiful property has been most ingeniously employed by MM. Arago and Fresnel, in measuring the refractive powers of different gases. For as the displacement of the coloured fringes depends on the refractive power, as well as thickness of the plate, its refractive power may be computed from the displacement. In the same manner, if one of the interfering rays are made to pass through tubes filled with different gases, while the other does not, the displacement produced by the gas will give a measure of the refractive power of the gaseous medium.

aunhofer

We come now to give some account of the experiments of Joseph Fraunhofer, made with instruments of extreme accuracy, and furnishing data of the highest importance in physical optics.[1]

The apparatus employed by Fraunhofer was a repeating theodolite, whose vernier read off to 4″. In the centre of the circle, but above it, this instrument carries a flat circular plate six inches in diameter, having its axis coincident with that of the theodolite, and graduated separately to 10″. In the middle of this disc is placed a metallic screen, in which the necessary apertures are made, and which is in the axis of the theodolite. The divisions of this disc serve to measure if necessary the angle of incidence of the rays. A telescope, having an object-glass of twenty lines in aperture, and 16·9 inches in focal length, is placed three-and-a-half inches from the centre of this disc. This telescope is placed firmly on the alidade of the divided circle, whose diameter is twelve inches, and the whole is counterpoised. The axis of the telescope is exactly parallel to the horizon, as well as to the plane of this circle. The magnifying power which he employed was from thirty to fifty times. The instrument did not communicate with the floor of the room, from which it was wholly insulated. The heliostate was placed in the prolongation of the optical axis, at a distance of 38 feet 7½ inches from the centre of the theodolite. In order to make the heliostate follow the sun in his hourly motion, the observer could move the screw of the mirror by means of a long rod of iron, which extends from the heliostate to the theodolite, and with this apparatus he could also vary at pleasure the intensity of the solar light. The opening of the heliostate is vertical, being two inches high, and commonly from the 50th to the 100th of an inch.

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By means of an achromatic microscope, magnifying 110 times, Fraunhofer measured the aperture in the metallic screen, which he did to the fifty-thousandth, and sometimes to the hundred-thousandth part of an inch, provided the body was very fine at its edge.

Fraunhofer's first observations were made with a single slit, which was placed before the object-glass of the telescope, which had been previously directed to the aperture in the heliostate, so that the aperture was bisected by the wire of the micrometer. He then saw the fringes shewn in fig. 7, Plate CCCLXXXI. The middle fringe or band $L^{I}L'$ bisected by the micrometrical wire K, was *white*, becoming yellow towards L^{I} and L^{II}, where it was red. In the space L^{I} L^{II} there is a spectrum with very lively colours, viz. *indigo* near L^{I}, then *blue*, *green*, *yellow*, and *red*, near L^{II}. The spectrum in L^{II} L^{III} is much less intense, viz. *blue* near L^{II}, and *yellow*, *green*, and *red* near L^{III}. The spectrum in the space L^{III}, L^{IV}, is still fainter, being *green* on the side L^{III}, and *red* on the side L^{IV}. A great number of spectra follow these, becoming fainter and fainter, and losing themselves in a band of light, which is spread over a great space. All these spectra on both sides of K are perfectly equal, and consequently symmetrical. Both the colours and the spectra shade into one another imperceptibly. The following table contains the average of the distances L^{I}, L^{II}, L^{III}, and L^{IV}, from the central line, all of them being equal, the measures being taken from the red extremity of each spectrum, so that if we wish to have the angle of deviation of L^{II} from KK we have only to multiply the value of L in the table by 2, and so on.

Width of the aperture in parts of a Paris inch.	Breadth of each spectrum or values of KL_{I}, EL^{II}, &c.	Product of the aperture by the deviation L.
0·11545	—37″·66	0·0000210
0·06098	1—11 ·17	0·0000210
0·03690	1—56 ·6	0·0000209
0·02346	3—4 ·43	0·0000210
0·01237	5—48 ·7	0·0000209
0·01210	6—1 ·84	0·0000212
0·01020	6—57 ·3	0·0000206
0·00671	11—6 ·4	0·0000217
0·00642	11—12 ·2	0·0000209
0.00337	21—10 ·3	0·0000207
0·00308	23—32 ·7	0.0000211
0·00218	33—40	0·0000213
0·00215	35—17	0.0000220
0·00114	1 4—53	0·0000215

From these observations, M. Fraunhofer deduces the following conclusions:

1. *That the angles of deviation of the luminous rays which pass through a single aperture, are in the inverse ratio of the width of that aperture.*

2. *That when a ray is diffracted in passing through a narrow aperture, the distance of similar rays from the middle in the several spectra, form in each case an arithmetical progression, whose difference is equal to the first term.*

3. *That if γ is the aperture, the arches L^{I}, L^{II}, or the deviation of the inflected rays, are in general for the radius of a circle equal to* 1, $L^{I}=\frac{0{\cdot}0000211}{\gamma}$, $L^{II}=2.\frac{0{\cdot}0000211}{\gamma}$

$$L^{III}=3.\ \frac{0{\cdot}0000211}{\gamma}.$$

By observing whether the micrometer were appeared or disappeared in the different spectra, Fraunhofer ascertained that the spectra nearest KK, are not composed of homo-

[1] *Neue Modifikation des Lichtes durch gegenseitige Einwirkung und Beugung der Strahlen, und Gesetze derselben.* Von Jos. Fraunhofer in Munchen. Without a date.

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geneous light, but that it becomes more and more homogeneous at greater distances from the axis.

Our author next proceeds to describe the phenomena observed when the two edges which form the narrow aperture, *are at different distances* from the object-glass. When the effective width of the aperture thus formed, is from the 25th to the 50th of an inch, the spectra are the same as those before described; but when the opening becomes less, the spectra on one side of the axis become wider, horizontally than those on the other side. When the apparent aperture was extremely narrow, the spectra on one was two or three times wider than those on the other. By continuing to close the distant edges, the longest spectra begin to disappear successively, so that the fifth spectrum for example, fills almost suddenly the whole field of the telescope, till it ceases to be visible, then the fourth spectrum presents the same phenomena, then the third, and so on. During these changes the spectra on the other side remain unchanged, but when all the former have vanished, *they also disappear in their turn, not successively, but all at once*, which happens when no light passes between the edges. The large spectra are always on the side of the screen, which is nearest the object-glass.

When the apertures, both in the heliostate, and in front of the object-glass, were small circular ones, a system of rings are produced, absolutely the same as those of thin plates, with this difference only, that the centre is *white* in place of *black*. The rays increase in size as the apertures diminish. By varying the apertures he obtained the following results:

1. *That the diameter of the coloured rings are in the inverse ratio of the diameter of the apertures.*

2. *That the distances of the extreme rings (of any given refrangibility) from the centre form an arithmetical progression, whose difference is smaller than the first term.*

3. *That if γ is the diameter of the aperture in Paris inches, we shall have*

$$L=\frac{0{\cdot}0000214}{\gamma}=L^{II}-L^{I}=L^{III}-L^{II}, \text{ \&c.}$$

$$L^{I}=\frac{0{\cdot}0000257}{\gamma}$$

$$L^{II}=\frac{0{\cdot}0000257}{\gamma}+L, \text{ and so on.}$$

Spectra produced by gratings andgrooves

The most important and interesting of Fraunhofer's researches, are those which relate to the spectra produced by gratings, consisting of a number of parallel wires placed parallel also to the narrow linear aperture in the heliostate. He formed these gratings of fine wires stretched across a rectangular frame; the two shorter ends of the frame consisted of two fine screws made with the same die, and having 260 threads in an inch. By placing a wire in each thread he ensured their exact parallelism. The diameter of each wire was 0·002021 of a French inch, and the edge of each wire was distant from the adjacent edge 0·003862 of an inch. The aperture of the heliostate was two inches long, and the 100th of an inch wide, and the frame of wires was placed before the object-glass, so that no other light could be admitted but through them. Fraunhofer was astonished at the phenomena which he saw. He saw the colourless line of light A, Plate CCCLXXXI, fig. 8, in the aperture of the heliostate, exactly as if no wires had been interposed, and at some distance from it on both sides *a great number of coloured spectra exactly similar to those produced by a good prism.* They were larger in proportion to their distance from the central bright line, and they diminished in intensity in the same proportion. A part of these spectra are shewn in figure 8, where A is the aperture of the heliostate, absolutely without colours. On each side of A the spectra are perfectly symmetrical. When the apparatus is well made, the space

Plate CCCLXXXI. Fig. 8.

AH^{I} is absolutely black. The *first* spectrum occupies the space H^{I}, C^{I}; H^{I} being the usual limit of the violet, and C^{I} that of the red. Between H^{II} and C^{II}, there is a second spectrum twice as long as the first; the order of the colours being the same, but their intensity a little less. The third spectrum occupies the space between C^{II} and F^{IV}, but a part of its violet rays are mixed with the red of the *second* spectrum, and also a part of the *red* rays of the *third* with the *blue* rays of the *fourth* spectrum. The *fourth* spectrum is seen between F^{IV} and D^{IV}, its *blue* extremity losing itself in the *third*, and its *red* extremity in the *fifth* spectrum. Many other spectra succeed these, and when the apparatus is good, *thirteen* may be easily reckoned on each side of A.

But what is the most interesting fact, when the apparatus is good, and the adjustments correct,—the *fixed dark lines in the prismatic* spectrum are seen at C^{I}, D^{I}, these lines being the same as those similarly marked in Plate CCCLXXXI, fig. 1. It is remarkable, however, that A is not seen, a fact which M. Fraunhofer neither notices nor explains. The lines both great and small, are absolutely the same, both in this and the prismatic spectrum, though their distances are widely different.

In a grating in which γ, the distance between the wires is 0·000628, and δ, or the diameter of the wires 0·001324, the following are the distances:

	Diffracted Spectrum.	Water Spectrum.
Distance between the lines B^{I} and C^{I}	2′ 2″·6	1′ 3″·3
—— C^{I} — D^{I}	4 23 2	2 41
—— D^{I} — E^{I}	4 5 ·2	3 16
—— E^{I} — F^{I}	2 39 ·9	2 47
—— F^{I} — G^{I}	3 37 ·6	5 57
—— G^{I} — H^{I}	2 12 ·5	4 14
Total length from B^{I} to H^{I}	19 1 0	19 1 ·3

The diffracted spectrum is therefore a very extraordinary one. The green space from E to F, is almost exactly the same in both, but all the less refrangible spaces are greatly expanded in the diffracted spectrum, and the more refrangible spaces greatly contracted, the *red* space CD in the diffracted spectrum being *twice as great* as in the water spectrum; and the *violet* space in the water spectrum twice as small.

M. Fraunhofer repeated the above experiments with *ten* different gratings, in which the breadth of the wires and the spaces between them were varied, and he deduces from them the following laws:

1. *For two different gratings in which the parallel wires are of the same size and placed at equal distances, the magnitude of the spectra which arise from the reciprocal influence of a great number of rays diffracted by narrow apertures, and their distances from the axis are in the inverse ratio of the intervals $\gamma+\delta$, that is the space from the middle of one of the openings to the middle of the other.*

2. *In all the perfect mean spectra, or those in which the fixed lines are seen, the distances between the coloured rays of the same nature in the different spectra, or between the same fixed lines in them, form an arithmetical progression, whose distance is equal to the first term.*

3. *In gratings in which the diameter δ of the wires and the distance γ between them is expressed in Paris inches, the first term of the progression for the fixed lines* B, C, D, E, *or those rays which have the corresponding degrees of refrangibility is represented by the following numbers.*

$$B=\frac{0.00002541}{\gamma+\delta};\quad C=\frac{0.00002425}{\gamma+\delta};\quad D=\frac{0.00002175}{\gamma+\delta};$$

$$F=\frac{0.00001943}{\gamma+\delta};\quad F=\frac{0.00001789}{\gamma+\delta};\quad G=\frac{0.00001585}{\gamma+\delta};$$

$$H=\frac{0.00001451}{\gamma+\delta}.$$

If we represent the numerator of each of these expressions by a, the angle of deviation of one of the same coloured rays in the *first* spectrum by ϑ'', in the *second* by ϑ'', in the *third* by ϑ''', we have generally

$$\vartheta' = \frac{\omega}{\gamma+\delta}, \quad \vartheta'' = \frac{\omega}{\gamma+\delta}, \text{ \&c.}$$

If ν stands for the number of the spectrum, ν being $=0$ for the axis, $=1$ for the first spectrum, 2 for the second spectrum, and if we put $E=\gamma+\delta$ we shall have in general,

$$\vartheta(\nu) = \frac{\nu\alpha}{\varepsilon}.$$

The preceding results having been obtained with angles so small that the arcs and their sines and tangents are nearly in the same proportion, M. Fraunhofer began a new series of experiments with the view of obtaining spectra, in which the angles should be larger and by which he might determine whether it was the arcs or their sines or tangents which had the proportions assigned by the experiments.

This inquiry rendered it necessary to obtain much finer gratings than those he had used. He therefore coated a plate of glass with two or three folds of gold leaf in order to have the interstices filled up, and by a peculiar arrangement he traced upon the glass parallel lines in which ε was $=0.00114$ of an inch. When the lines were drawn closer, no gold remained upon the glass. With this system the spectra were larger, and the fixed lines distinctly seen, but they did not answer his purpose. He therefore thought of spun glass which answered as well as wires; and having covered a plate of glass with a thin coat of fat, so thin that it could scarcely be seen, he traced parallel lines upon it, the intervals of which were only half the size of those on the gold leaf. The spectra produced by this system of lines gave the fixed lines very distinctly, so that their distances from the axis could be accurately measured; but he could not succeed in tracing either upon a layer of fat or black varnish lines closer than this. He at last succeeded in his object of tracing a finer system of lines by using a diamond, with which, by the aid of a machine, he traced lines so fine upon the surface of glass, that they could not be seen by the most powerful compound microscope. In this way he obtained a set of several thousand lines in which $\varepsilon=0.0001223$ of an inch, and which are at distances so very equal, that the fixed lines in the first and second spectrum are clearly seen.[1]

With the system when $\varepsilon=0.0001223$, and the number of lines 3601, the fixed line D is seen double in the first spectrum.

When the light fell vertically on this grating, Fraunhofer obtained the following measures:

Names of fixed lines.	Distance of fixed lines from the axis A. Fig. 8, Plate 1.	Distance of lines in first spectrum.
C^{I}	11° 25′ 20″	C^{I} from D^{I}
C^{II}	23 19 42	1° 10′ 49″
D^{V}	10 14 31	D^{I} from E^{I}
D^{II}	20 49 44	1 5 31
E^{I}	9 9 0	E^{I} from F^{I}
E^{II}	18 32 34	0 32 54
F^{I}	8 26 6	F^{I} from G^{I}
F^{II}	17 3 34	0 58 47
G^{I}	7 27 19	G^{I} from H^{I}
G^{II}	15 3 9	0 34 43
H^{I}	6 52 36	

With this grating, the *third*, *fourth*, and following spectra were well seen, but the fixed lines could not be seen with sufficient distinctness for accurate measurement in those beyond the *first* and *second*.

He therefore used another grating in which $\varepsilon=0.005919$ of an inch; and when the light fell upon it vertically, he obtained the following results for the first five spectra, with the lines D, E, and F, for the first four, with E, for the first three with F and G, and the first two for H.

Names of fixed lines.	Distance of fixed lines from axis.	Names of fixed lines.	Distance of fixed lines from axis.
C^{I}	2° 20 57	E^{V}	9 28 3
D^{I}	2 6 30	F^{I}	1 44 19
D^{II}	4 13 7	F^{II}	3 28 45
D^{III}	6 20 7	F^{III}	5 13 23
D^{IV}	8 27 43	F^{IV}	6 58 18
D^{V}	10 35 53	G^{I}	1 32 22
E^{I}	1 53 7	G^{II}	3 4 57
E^{II}	3 46 17	G^{III}	4 37 30
E^{III}	5 39 50	H^{I}	1 27 0
E^{IV}	7 33 41	H^{II}	2 50 11

all the observations made with both the systems of lines are represented by the expression

$$\operatorname{Sin} \vartheta^{(\nu)} = \frac{\nu\omega}{}.$$

That is with rays falling vertically, the sines of the angle of deviation of any fixed line or ray of definite refrangibility from the axis in the different spectra which succeed others, are as the numbers 1, 2, 3, 4, 5.

The last of these systems of lines has the remarkable property of having all the spectra on one side of the axis twice as luminous as those on the other. Fraunhofer supposed that one of the sides of each line had been sharper than the other, and confirmed this opinion by tracing lines on a layer of fat, so that one line was less sharp than the other, and it produced the same inequality in the intensity of the light of the spectra on each side of the axis.

If the ray does not fall vertically upon the system of grooves or lines, but is inclined to it in a plane which intersects the parallel lines vertically, the same effect is produced as if the distance between the middle of the lines or ϵ were diminished in the ratio of the radius to the cosine of the angle of incidence. Hence *the distance of the spectra from the axis increases as the cosine of the angle of incidence.* If σ therefore is the angle of incidence, then we have $\sin \vartheta^{(\nu)} = \frac{\nu a}{\epsilon \cos. \sigma}$. This, however, is only true when the system of lines is coarse and σ not very large. But in fine systems of lines it is otherwise, the spectra on both sides of the axis are no longer symmetrical, and in the system where $\varepsilon=0.0001223$, when σ is $=55°$ we have the deviation of D′ on one side of the axis is $=15°16'$, and on the other side of the same axis 30° 33′.

Hitherto we have treated of spectra formed by the light transmitted through the gratings, or through plates of glass with systems of lines etched upon one of its surfaces. But M. Fraunhofer examined also the spectra produced by *reflexion* from the etched surfaces of the glass plates. For this purpose, he coated the surface of the glass with a black resinous varnish of the same refractive power as the glass. Then when light reflected from the system

[1] M. Fraunhofer remarks that it requires much good fortune even with $\varepsilon=0.0001223$ to find a diamond point which shall trace *several thousands* of such lines without being altered, and he had succeeded only in obtaining one system. It is only by trial that an useful diamond point can be obtained. As every line requires to be drawn singly with great care, the labour of drawing two thousand is enormous. Fraunhofer has drawn lines so close that there are 32,000 of them in a Paris inch. By etching the first and last line of the system somewhat stronger than the rest, our author, by a microscopic apparatus, measured the distance between these two lines, the etching machine itself reading the lines which are etched. In this way knowing the number of lines, viz. 3601, and the distance between the first and last, he obtained ε or the distance between the middle of any two lines.

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of lines fell on the object-glass of the telescope, the very same phenomena appeared as when the light passed through the same system of lines at the same angle of inclination, spectra not symmetrical being seen. The intensity of the spectra was still such that the distances of the various lines can be determined with great accuracy.

M. Fraunhofer has noticed it as very remarkable that under a certain angle of incidence a *portion of a spectrum* produced by reflexion, consists of entirely polarised light. This angle of incidence varies greatly for the different spectra, and even still very perceptibly for the different colours of one and the same spectrum. Thus with the glass system of lines where $\epsilon = 0.0001223$, the ray E^{I} in the green part of the first spectrum is polarised when $\sigma = 49°$, but the same green part of the *second* spectrum on the same side of the axis is only polarised when $\sigma = 40°$, and the green part of the first spectrum lying on the opposite side of the axis, is not polarised till $\sigma = 69°$. In this last case the remaining colours of the spectrum are imperfectly polarised. This was less the case in the second spectrum above mentioned where the colour still remained polarised when the angle of incidence was perceptibly altered. In the spectrum where the green light was polarised at 69°, the light was at no angle of incidence so completely polarised as in the first spectrum at 49°. With a system of lines in which ϵ is larger than the one above mentioned, the green rays in the spectra already referred to, are polarised at totally different angles of incidence.

A very singular consequence arises from the formula deduced from theory by M. Fraunhofer, and representing his experiments. If the distance ϵ between the lines is less than the length of an undulation, and the light falls vertically on the grating, so that $\sigma = o$, it follows that *no coloured ray remains visible*, however the light may fall, and only the *white* light becomes visible in the axis. Hence all scratches or inequalities on polished surfaces can produce no spectra, or no disturbance in the light which the surface refracts or reflects, and consequently no imperfection in the images which they form. M. Fraunhofer likewise draws the conclusion "that it would be impossible by any means to render such inequalities (those less than ω) visible," and that a microscopic object, the diameter of which is $= \omega$, and consists of two parts, cannot be recognised as consisting of two parts. "This," he adds, "shews us the limits which are set to vision through microscopes." This result, if clearly established, would be a very remarkable one.

It is very obvious, that if the distances of the etched lines or the wires in gratings are unequal, the *larger* distances ϵ will give *smaller* spectra, and the *smaller* distances ϵ *larger* spectra, which will be mixed with each other. Fraunhofer, however, conceived it would be interesting to know what would happen if the intervals ϵ were *regularly unequal*, that is, if the unequality in the distances were regularly repeated in equal parts. With this view he etched parallel lines in various ways, regularly unequal upon plates of glass covered with gold leaf. If the distances between the lines are expressed by ϵ', ϵ'', ϵ''' and if one of the equal parts, which consists of unequal ϵ's is expressed by $\epsilon' + \epsilon'' + \epsilon''' - - - + \epsilon^n$ then the distances of the various spectra were found by experiment to be

$$\text{Sin. } \vartheta = {}^{(\nu)} \frac{\nu \omega}{\epsilon' + \epsilon + \epsilon^n - - - + \epsilon^n}$$

The phenomena of spectra thus produced are chiefly remarkable on account of their different intensity. With some systems of lines of this kind, *several spectra or parts of them may be wholly wanting*, or have so slight an intensity that they are not easily observed, whilst the succeeding ones again become very intense. Owing to this cause, the fixed lines in these spectra may be observed. In the usual systems consisting of equal spaces ϵ, the lines C^{XII}, F^{XII} or the fixed lines C, F, in the twelfth spectrum can be seen; but with a regularly unequal system of lines, where every division consists of three shades ϵ different among themselves, and are as 25 : 33 : 42, the lines C^{XII}, D^{XII}, E^{XII}, and F^{XII} are seen with such distinctness that their distances from the axis can be accurately measured. The reason of this is, that with such systems of lines, the tenth and the eleventh spectra are almost wholly wanting. With this system of lines, indeed, Fraunhofer saw E^{XXIV} or the line E in the 24th spectrum so distinctly that its distance could be measured.

M. Fraunhofer, by means of concentric circular lines etched upon glass at equal distances, and by making the aperture in the heliostate circular, has produced circular spectra with circular fixed lines. Their distances from the axis are in the same proportion as in the spectra produced by parallel lines.

When the gratings and systems of lines are immersed in fluids, the same phenomena are produced, but the distances of all the spectra from the axis are diminished in the inverse ratio of the indices of refraction.

Fraunhofer has given also some fine drawings of a beautiful class of phenomena produced by the diffraction of light passing through round and quadrangular apertures either singly or arranged regularly. When a plate of brass perforated with two equal apertures 0·02227 of an inch in diameter, and 0·03831 distant, is placed in front of the object glass, and the aperture of the heliostate round, the extraordinary appearance shewn in fig. 9, plate CCCLXXXII, was seen. It consisted of 65 elliptical spectra distributed in concentric rings, the outermost of which contains 28 spectra, the next 20, the next 12, and the central one five. When the circular apertures are arranged so as to correspond with the four angles of a square, the effect produced is similar to fig. 10.

Plate CCCLXXXII. fig. 9.

Fig.

One of the most splendid figures of this kind is produced by crossing two gratings with the wires at right angles to each other, a circular image is covered with narrow spectra radiating from the centre, but occupying only parts of different radii. The spectra are rectangular of about a line wide, and from five lines to five inches long. The violet end of each is towards the centre. In some places the spectra touch and overlap each other, but the greater number are insulated.

Our limits will not permit us to pursue this most curious subject any farther, and we must refer our readers to Fraunhofer's own work,[1] and to another recently published by Schwerd of Spires in 1835,[2] in which he has given drawings of an immense variety of beautiful phenomena, all of which are capable of being explained by the undulatory theory.

As the various phenomena of diffraction observed by Arago, Fresnel, Young, Fraunhofer, and Schwerd, are susceptible of being explained by the undulatory theory, even facts of the same class, and having a similar origin, cannot possess much interest in our inquiries into the physical causes to which they must be ultimately referred.

Recent discoveries.

We shall now proceed, however, to give an account of a new series of facts discovered by Sir David Brewster, of which the undulatory theory is not capable in its present form of giving the least explanation, and we must there-

[1] See *Edin. Journal of Science*, N. S. No. xiii. p. 101, and No. xiv. p. 251.

[2] *Die Beugungs-ersheinungen, aus dem Fundamental-gesetz dem undulations theorie analytische entwickelt und in Bieldern dargestellt*, Von F. M. Schwerd, Manheim, 1835.

fore consider such facts as peculiarly calculated to throw light on the physical cause of the phenomena.

In all the phenomena of gratings and systems of lines observed by Fraunhofer, the central image of the luminous aperture in the heliostate is white, a result that might have been expected, as that light is reflected from the original surface of the glass, and cannot interfere with any other light. "If the lines," says Fraunhofer, "were so thick that one touched another, and consequently had no space between them, no light could be regularly reflected from the etched surface, and would, as from every other polished surface, be dispersed. Were the intermediate spaces equally wide as the lines, the etched surface could only regularly reflect half as much light as an equal surface of glass that was not etched, therefore the quantity of regularly reflected light from an etched surface of glass, is in proportion to the quantity of light which is reflected from a surface of glass of the same size not etched, or as the width of the spaces between any two neighbouring lines is to the width of these lines."[1]

These conclusions however irresistible they seem to be, are very far from having any foundation. For upon examining a series of several systems of lines or grooves cut on steel for him by the late Sir John Barton, Sir David Brewster observed, that in several of them the central image hitherto described as *white* or colourless, had a distinct colour which was the same in every part of the system. In one of the systems on which there were 1000 lines in an inch, the central image had its tint a *greenish blue* at a perpendicular incidence, which suffered no change by turning round the plate, nor by reflecting the light from different parts of the system. He found the same colours on various other systems of lines, and upon examining them at different angles of incidence, he found that the tints varied with the incidence, being a maximum at a vertical incidence, diminishing as the incidence increased, and disappearing at an angle of 90°. The following were the general results with the grooves on steel :—

Number of grooves in the inch.	Orders and portions of orders of colours from 0° to 90° of incidence.
500	Citron yellow of the first order shading to white.
625	One complete order of colours, together with the reddish yellow of the second order. The colours very faint.
1000	Four complete orders of colours.
1000	One complete order, with blue, green, and yellowish green of the second order.
1250	One complete order, with blue and bluish green of the second order. The colours very faint.
2000	One complete order, together with blue, green, and greenish yellow of the second order.
2500	One complete order, together with the full blue of the second order.
3333	Gamboge yellow of the first order.
5000	One complete order, together with bluish white of the second order.
10,000	One complete order with blue and fainter blue of the second order.

In the third specimen, with 1000 grooves, mentioned in this table, the following were the four orders of colours:—

Colours.	Angles of incidence.
White	90° 0′
Yellow	80 ½
Reddish orange	77 ½
Pink	76 20
Junction of Pink and blue	75 40
Brilliant blue	74° 30′
Whitish	71
Yellow	64 45
Pink	59 45
Junction of pink and blue.	58 10
Blue	56
Bluish green	54 30
Yellowish green	53 15
Whitish green	51
Whitish yellow	49
Yellow	47 15
Pinkish yellow	41
Pink red	36
Whitish pink	31
Green	24
Yellow	10
Reddish	0

These colours are obviously analogous to those of the reflected rings in thin plates, though with a white centre, but they *have not the same composition.* By turning the system of lines round in azimuth, the same colours are seen at the same angles of incidence, and they suffer no change either by varying the distance of the luminous aperture, or the distance of the eye of the observer.

Desirous of seeing what effect would be produced, when the original surface of the steel was almost wholly removed, Sir John Barton executed for our author a specimen with 2000 grooves in an inch, in which this was nearly effected. Unfortunately, however, the diamond point which he used broke before he had executed any considerable space, and the experiments, therefore, with so small a portion, were less complete than could have been desired.

The specimen, however, gave four orders of colours, which were developed at greater angles of incidence than in the preceding table. The following were the results :—

Colours.	Angles of incidence.
White	90° 0′
Straw yellow	
Faint red	
Pink	
First limit of pink and blue	80 00
Blue	
Green	
Yellow	
Red	
Pink	
Second limit of pink and blue	69 40
Blue	
Green	
Yellowish green	
Yellow	
Orange	
Scarlet	
Purple	
Third limit of pink and blue	48 0
Blue	
Brilliant green	
Yellowish green	
Yellow	
Reddish	10 0

The property established by the preceding experiment is certainly one of a very remarkable kind. That a pure and highly polished metallic surface, which reflects light perfectly white, should actually decompose it when the surface is reduced to narrow lines, is inconsistent with every doctrine respecting light. Here there are no rays to interfere,

[1] Fraunhofer, *Edin. Journal of Science*, No. xiii. p.109.

no doubly refracted pencils, and in short, none of the ordinary conditions on which the decomposition of light depends. That the colour does not arise from light that has entered a certain way into the body interfering with that which is regularly reflected, is obvious from the fact, that in two specimens of 2000 grooves in an inch, impressed on *black* wax, the new colours were very distinct, the vertical tint being a greenish yellow of the second order, in one specimen, and a gamboge yellow in the other, in addition to one complete order of colours at greater incidences.

The following experiments, intended to shew the effect of a variable refracting power in the reflecting surface, are calculated to give us some insight into the nature of this new property of light. In the following table Sir David Brewster has described the changes produced upon the colours, by placing different fluids on the reflecting surface:—

No. of grooves in an inch.	Maximum vertical tint without a fluid.	Maximum tint with three different fluids.
$312\frac{1}{2}$	No colour	1. Water; tinge of yellow. 2. Alcohol; tinge of yellow. 3. Oil of cassia; faint reddish yellow.
500	Citron yellow of first order	1. Water; tinge of red. 2. Alcohol; diluted pink. 3. Oil of cassia; a bluer pink.
625	Reddish yellow of second order	1. Water; faint pink of second order 2. Alcohol; ditto more pink. 3. Oil of cassia; bluish pink of second order.
1,000	Yellowish green of second order	1. Water; pinkish red, second order. 2. Alcohol; brilliant pink, ditto. 3. Oil of cassia; greenish blue, third order.
1,250	Bluish green, faint	1. Water; yellow, second order. 2. Alcohol; yellower. 3. Oil of cassia; yellowish pink.
2,000	Greenish yellow, second order	1. Water; brownish red, second order. 2. Alcohol; pinkish red, ditto. 3. Oil of cassia; greenish blue.
2,500	Blue, second order	1. Water; dilute green. 2. Alcohol; greenish white, second order. 3. Oil of cassia; bright gamboge yellow.
3,333	Gamboge yellow, first order	1. Water; pinkish red, first order. 2. Alcohol; reddish pink. 3. Oil of cassia; bright blue, second order.
5,000	Bluish white, second order	1. Water; pale yellow. 2. Alcohol; yellow, with tinge of orange. 3. Oil of cassia; yellowish pink, second order.
10,000	Fine blue, second order	1. Water; greenish white, second order. 2. Alcohol; yellowish white. 3. Oil of cassia; brilliant gamboge yellow.

Similar results were obtained with grooves impressed upon wax, so that it follows that more orders of colours, and higher tints, at a given incidence, are developed by diminishing the refractive power of the grooved surface. But one of the most interesting results in this table is the part in which the colours are entirely developed by the fluids applied to the surface; and hence if we had transparent fluids of much higher refractive powers, the colours would be produced when the intervals were much larger.

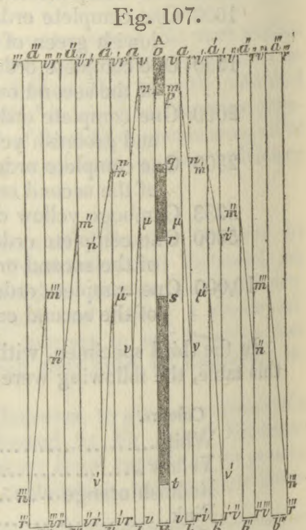
Similar phenomena were developed when the grooves were impressed on the fusible metal, on tin, and on isinglass. In those on isinglass, the new colours were seen also in the transmitted central image, and were extremely brilliant; but they were not decidedly complementary to those in the reflected image. The following were the colours of the reflected and transmitted image in isinglass, beginning from 90° of incidence:—

Colour of the reflected central image.	Colour of the same image, seen by transmission.
Yellow	Deep blue.
Orange	Paler blue.
Pink	Blue.
First limit of pink and blue	Blue.
Blue	Pink.
Green	Orange pink.
Yellow	Orange.
Orange	Yellow.
Pink	Yellow.
Second limit of pink and blue	Yellow.
Blue	Yellow.

Our author was now desirous of observing what took place in the prismatic images, when the colours appeared in the principal or central image.

Let AB, fig. 107, be the reflected image of a long rectangular aperture from the spaces between the grooves, and ab, $a'b'$, $a''b''$, $a'''b'''$, the prismatic images of it, vv, $v'v'$, &c. being the violet sides, and rr, $r'r'$, &c. the red sides of these spectra. Then in the

Fig. 107.



First spectrum ab, the *violet* rays are obliterated at m at an incidence of 74°, and the *red* rays at n at an incidence of 66°, the intermediate colours, blue, green, being obliterated at intermediate points between m and n, and at angles of incidence intermediate between 74° and 66°. In the

Second spectrum $a'b'$, the *violet* rays are obliterated at m' at an incidence of 66° 20′, and the *red* at n' at 54° 45′. In the

Third spectrum $a''b''$, the *violet* rays are obliterated at m'' at 57°, and the *red* at n'' at 41° 35′. And in the

Fourth spectrum $a'''b'''$, the *violet* rays are obliterated at m''' at 48°, and the *red* rays at n''' at 23° 30′.

Periodical Colours.

Another similar succession of obliterated tints takes place on all the prismatic images at a lesser incidence, as shown at $\mu\nu$, $\mu'\nu'$, the *violet* being obliterated at μ, and the *red* at ν, and the intermediate colours at intermediate points. In this second succession the line $\mu\nu$ begins and ends at the same angle of incidence, as the line $m''n''$ in the third prismatic image $a''b'$; and the line $\mu'\nu'$ on the second prismatic image corresponds with $m'''n'''$ on the fourth prismatic image.

Fig. 108.

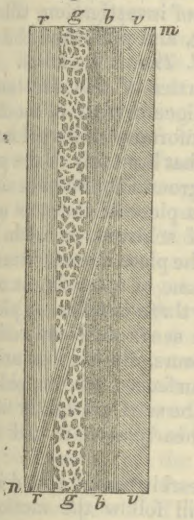
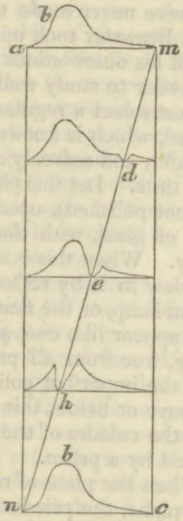


Fig. 109.



This singular obliteration of the colours is shown more clearly in fig. 108, where *rmvn* is a part of one of the prismatic images, *rr* the red space, *gg* the green space, *bb* the blue, and *vv* the violet space. The line of obliteration *mn* begins at *m*, the extreme violet being obliterated there, so that the curve of illumination *abm*, fig. 109, is just affected at one extremity *m*. The line advances into the spectrum, and at the point corresponding to *d*, fig. 109, a portion of the blue and violet is obliterated, as shown by the notch in the curve; at *e* a portion of the green and blue; at *h* a portion of the red and green, and at *n* the extreme red.

A similar obliteration of tints takes place on the ordinary image AB.

The first obliteration, viz. that of the violet, takes place at *o*, fig. 107, and that of the red at *p*; while the intermediate colours disappear at intermediate points. This first space of obliteration has no corresponding one at the same incidence in any of the prismatic images.

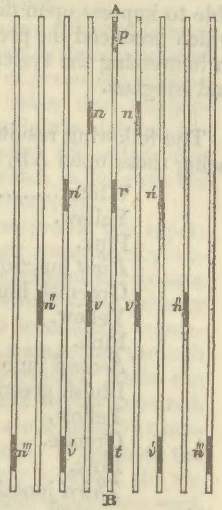
The second obliteration of the violet in AB takes place at *q*, and that of the red at *r*, and this corresponds in incidence with the obliterations $m'n'$, $m'n'$ on the second prismatic image.

The third obliteration of the violet takes place at *s*, and that of the red at *t*, and this corresponds in incidence with the four obliterations on the second and fourth prismatic images, viz. $\mu\nu$, $\mu'\nu'$, $m'''n'''$, $m'''n'''$.

In all these phenomena the points m, n, μ, ν, &c. are only the points of minimum intensity, or of maximum obliteration; for the tints never entirely disappear, and those obliterated at each line *mn* form an oblique spectrum containing all the prismatic colours.

The analysis of these curious and apparently complicated phenomena becomes very simple when they are examined under homogeneous illumination. The effect produced in red light is represented in fig. 110, where AB is the image of the rectangular aperture reflected from the faces *n* of the steel, and the four images on each side of it correspond with the prismatic images. All these nine images, however, consist of homogeneous red light, which is obliterated at the fifteen shaded rectangles, which are the minima of the new series of periodical colours which cross both the ordinary and the prismatic images. The centres p, r, t, n, ν, &c. of these rectangles correspond with the points marked with the same letters in fig. 107; and if we had drawn the same figure for violet light, the centres of the rectangles would have corresponded with o, q, s, m, μ, &c. in fig. 107. The rectangles should have been shaded off to represent the phenomena accurately, but the only object of the figure is to shew to the eye the position and relations of the minima of the periods.

Fig. 110.



If it should be practicable to remove a still greater portion of the faces *n*, the first minimum *p*, fig. 110, would commence at a greater angle of incidence; and other two rows of minima, namely, rows of five and six, would be found extending to the fifth and sixth prismatic images. The arrangement and succession of these is easily deducible from fig. 110, where the law of the phenomenon is obvious to the eye.

The following table contains the angles of incidence reckoned from the perpendicular at which these minima occur in the extreme rays.

Position of the minima in red light.

	Ord. Im.	1st Prism Im.	2d Prism Im.	3d Prism Im.	4th Prism Im.
First minima *p*...	76° 0′	66° 0′	55° 45′	41° 35′	23° 30′
Second minima *r*	55 45	41 35	23 30		
Third minima....	23 30				

Position of the minima in violet light.

	Ord. Im.	1st Prism Im.	2d Prism Im.	3d Prism Im.	4th Prism Im.
First minima	81° 30′	74°	66° 20′	57°	48°
Second minima...	66 20	57	48		
Third minima...	48				

When the steel with 1000 grooves is exposed to common light, and the incident ray is very near the perpendicular, the 5th, 6th, 7th, and 8th prismatic images are combined into a mass of whitish light, terminated externally by a black space. As the angle of incidence increases, the 6th, 7th, 8th, and 9th images are combined into this mass, then the 7th, 8th, 9th, and 10th images, and so on; the black space which terminates this mass receding from the axis or image AB, fig. 107, as the obliquity of the incident ray increases.

Having covered the steel plate with water and oil of cassia in succession, I found the angular distances of the black space to be as follows at the same incidence:—

Air..................................	12° 23′
Water................................	17 15
Oil of cassia........................	21 22

the sines of which are inversely as the indices of refraction of the fluids.

Phenomena analogous to those above described take place on the grooved surfaces of gold, silver, and calcareous spar, &c.

In order to study this subject under a more general aspect, I was desirous of examining the phenomena exhibited by grooved surfaces of different refractive powers. It was

Periodical Colours.

obviously impossible to procure systems of lines upon transparent bodies in which the grooves should have exactly the same distance and magnitude; but I conceived it practicable to impress upon different substances the very grooves which produced the preceding phenomena, and I succeeded in impressing the system of 1000 grooves upon tin, realgar, and isinglass.

The following results were obtained with *tin*, the colours being those upon AB, fig. 107 :—

White	90°	0′
Yellow.		
Pink.		
First junction of pink and blue	76	20
Greenish blue.		
Yellow.		
Pink.		
Second junction of pink and blue	57	40
Bluish green.		
Yellow.		
Orange.		
Pink.		
Third junction of pink and blue.		
First minimum of red	76°	
Second ———	61	

The following results were obtained with *realgar* :—

White	90°	0′
Yellow	80	
Pink	75	30
First junction of pink and blue	73	10
Blue	72	
Bluish green	70	15
Yellow	63	
Bright pink	54	
Second junction of pink and blue	47	
Bluish green	41	
Yellow	36	
Pink	32	
More and more pink.		
First minimum of red	72°	0′
Second ———	61	15

The following results were obtained with *isinglass*. The colours were generally the same as in the steel :—

The first limit of pink and blue was at	75°	45′
The blue of second order	73	45
The second limit of pink and blue was at	54	30

In these experiments the tin gave nearly the same results as the steel; but in the realgar and the isinglass similar tints were produced at a less angle of incidence than in the steel. The minima of the periods were exhibited very finely on the isinglass, and were produced at smaller angles of incidence.

In a specimen with 1000 grooves upon isinglass, the third pink, or that seen upon steel at 36°, was the highest; but after drying, the pink descended to yellow, and subsequently to green.

If the isinglass is removed from the steel when it is still soft, the edges of the grooves get rounded and lose their sharpness, and only one prismatic image is seen on each side of the ordinary image, as in mother-of-pearl.

The mass of white light is finely seen in the impressions taken upon tin, but never appears upon isinglass.

The prismatic colours seen on mother-of-pearl are exactly of the same kind as the prismatic images of grooved surfaces, with this difference, that a single prismatic image only is seen on each side of the common colourless image. The following account of these colours has been given by Sir David Brewster, who first analysed them, and discovered their communicability to wax, the fusible metals, &c.

Properties of mother-of-pearl.

Mother-of-pearl, which constitutes the interior lining of the shell of the pearl oyster, and of various other shells, has been long employed in the arts for the purposes of use and of ornament. Every one must have observed the play of prismatic tints, from which this substance derives much of its value as an ornament; but the nature and origin of these tints were never made the subject of investigation, till Sir David Brewster took up the subject, and published the results of his observations in the *Phil. Trans.* for 1814.

In order to study well the properties of this substance, we must select a regularly formed piece or plate of mother-of-pearl, which is known by the uniformity of its colour in day-light, and scarcely exhibits in that light any of the prismatic tints. Let this plate be now ground flat on both sides, (but not polished), upon a hone or a piece of slate, or upon a bit of glass, with the powder of schistus, or with fine emery. When this is done, hold the plate close to the eye, and view in it by reflexion the flame of a candle, or of an argand lamp, or the flame of two or three candles, so placed as to appear like one, and we shall see a dull and reddish image, free from all prismatic colours, its dulness arising from the imperfect polish of the surface. On one side of, or above or below, this image, will be seen a brighter image with the colours of the spectrum, nearly as if it had been formed by a prism.

When the plate of mother-of-pearl is turned round in its own plane, the prismatic image will follow the motion of the plate, and revolve round the common image, the *blue* rays being nearest the common image, and the *red* rays farthest from it. If the plate is so placed that the prismatic image is in the plane of reflexion, and between the common image and the observer, it will be found that the distance between the two images increases with the angle of incidence, being about 2° 7′ at an incidence not far from the perpendicular, and 9° 14′ at a very great obliquity. This distance between the images varies more rapidly when the plate is turned round 180° in azimuth, so that the common image is between the prismatic image and the observer; but in this case we cannot measure the angle accurately much beyond 60°, when it is nearly 4° 30′.

Beyond the prismatic image, and in the same line with it and the common image, will be observed a mass of coloured light, nearly as far beyond the prismatic image as the prismatic image is from the common image. The distance of this patch of coloured light varies according to a different law from that of the prismatic image, as the rays which form it have previously suffered refraction. This mass of light has a beautiful *crimson* colour at great angles of obliquity. At 37° of incidence it is *green*, and at less angles it has a *yellow* hue, approaching to *white*, and becomes very luminous. These colours become more brilliant when the plate is polished, and have an origin quite different from those of the prismatic image.[1]

Hitherto we have considered the phenomena only when the surface has that degree of polish which accompanies smooth grinding. If a greater degree of polish, however, is communicated to the plate, the common image becomes more brilliant, and *a new prismatic image starts up, diametrically opposite to the first prismatic image, and at the same distance from the common image.* This second prismatic image resembles in every respect the first. Its brilliancy increases with the polish, and when this polish is very high, the second prismatic image is nearly as bright as

[1] See *Phil. Trans.* 1836, p. 55.

the first, which has its brilliancy a little impaired by polishing. This second image is never accompanied, like the first, by a mass of coloured light. If the polish of the surface is removed by grinding, the second prismatic image vanishes, and the first resumes its primitive brilliancy.

When the preceding experiments are repeated on the opposite surface of the plate of mother-of-pearl, the same phenomena are observed, but in a *reverse* order, the first prismatic image and the mass of coloured light being now seen on the opposite side of the plate.

In examining the light transmitted through the mother-of-pearl, we shall perceive analogous phenomena. A coloured image will be seen on each side of the common image, having the same angular distance from it as those seen by reflexion, and resembling them in every particular; the blue light being nearest the common image, and the red light farthest from it. These two images, however, are generally fainter than those seen by reflexion. When the second prismatic image is extinguished by removing the polish, it is then the most brilliant when seen by transmission; and, in general, the image which is brightest by reflexion is faintest by transmission, and *vice versa*.

In measuring the angular distances of the prismatic image from the common image seen by reflexion, Sir David Brewster had occasion to fix the mother-of-pearl to a goniometer by means of a cement made of rosin and bees' wax. Upon removing it from the cement, by insinuating the edge of a knife, and making it spring off, the plate of mother-of-pearl left a clean impression of its own surface; and he was surprised to observe, that the cement had actually received the property of producing the colours which were exhibited by the mother-of-pearl. This was at first attributed by our author, and others who saw the experiments, to a very thin film of mother-of-pearl detached from the plate, and left upon the cement; but subsequent experiments convinced him that the mother-of-pearl communicated to the cement its own properties.

In order to shew this remarkable property to advantage, the plate of mother-of-pearl should be fixed to a handle like a seal, and its surface carefully cleaned. The sealing-wax should be black, and the impression taken by an impulse of the plate against the black sealing-wax, when rendered as fluid as possible by heat.

The properties of mother-of-pearl may also be communicated in this way to *balsam of tolu*, *gum-arabic*, *gold leaf* placed upon wax, *tinfoil*, the *fusible metal* composed of bismuth and mercury, and to *lead*, by hard pressure, or the blow of a hammer. When the impression is first made upon the *fusible metal*, the play of colours is singularly fine; but the metallic surface soon loses its polish, and the colours gradually decay.

If dissolved *isinglass* or *gum-arabic*, &c., are placed upon the plate of mother-of-pearl, and allowed to harden upon it, they will exhibit in the most splendid manner the colours of the substance; or if we indurate these gums between two plates of mother-of-pearl, we shall have transparent films, exhibiting on both sides the play of the prismatic tints.

In order to show that in these cases no part of the mother-of-pearl is left on the surface, Sir David Brewster plunged a piece of wax, with the impression, into nitric acid, which would instantly have destroyed the carbonate of lime, of which the mother-of-pearl is chiefly composed, but it had no effect on the colorific property of the surface. In soft cements, made of bees' wax and rosin, the slightest degree of heat destroys the superficial configuration, by which the colour is produced. In *sealing-wax*, *isinglass*, *gum-arabic*, and *realgar*, a much greater heat is necessary to destroy it; but in *tinfoil* and *lead*, its destruction can only be effected by the temperature at which they cease to become solid.

If we now examine the prismatic images *reflected* from the wax which has received the impression from an unpolished piece of mother-of-pearl, we shall find that the single prismatic image which is thus produced is on the *right hand* of the common image, whereas it is on the *left hand* of the common image in the mother-of-pearl itself.

At different angles of incidence, the two coloured images formed by the wax, follow the same laws as those produced by the mother-of-pearl; but the mass of *green* and *crimson* tints never appears in the impressions taken from mother-of-pearl, because they are produced by light which has penetrated the mother-of-pearl, and has after refraction been reflected from one or more thin plates which lie between the strata of which the mother-of-pearl is composed.

In communicating to *isinglass* or *gum-arabic* the superficial structure of mother-of-pearl, their transparency enables us to observe the phenomena of the transmitted colours. The two prismatic images were both visible—the primary one being remarkably brilliant, and the second one scarcely perceptible; but when the light was transmitted through the gum, the primary image was nearly extinct, while the secondary one was unusually brilliant and highly coloured, far surpassing in splendour those which are formed by transmission through the mother-of-pearl itself. When both the surfaces of isinglass or gum-arabic have received the superficial structure of mother-of-pearl, four images are seen. The *transmitted* colours are more brilliant in *gum-arabic* than in *balsam of tolu*, as the latter reflects more light; but the prismatic images have the same degree of colour or dispersion when formed by *isinglass* or *gum-arabic*, as when they are formed upon *metallic* surfaces.

From these facts it is obvious that the principal phenomena of mother-of-pearl have their origin in a particular configuration of its surface. By the use of the microscope Sir David Brewster discovered in every specimen of mother-of-pearl that gave the prismatic images, a grooved structure upon its surface, resembling the delicate texture of the skin at the tip of an infant's finger, or the lines which mark out islands and coasts upon a map.

In many specimens of mother-of-pearl, the grooves are parallel, but they are often arranged in all possible directions like the veins of agate, and in this case the common reflected image is surrounded with a number of prismatic images sometimes arranged in a circular or oval form, more or less regular. Sometimes the spaces between the grooves, or rather the edges of the strata of the shell, can be seen by the naked eye, or by a magnifying power of six or eight times, in which case the prismatic images are less highly coloured, having whitish light in their centre, and are placed close to the common image. At other parts of the same plate, more than 3000 grooves may be counted in an inch, and in some places they cannot be detected by ordinary magnifying powers. When the spaces between the grooves are wide, a new groove often begins, and there is often a sudden change from a series of wide grooves to a series of close ones. When the mother-of-pearl is scratched, the bottom and sides of the scratches are grooved exactly like the parts that are polished.

The direction of the grooves is always at right angles to the line joining the common image and the prismatic image. Had the grooved structure appeared only upon its external surface, the phenomena and the communicable colours would have disappeared when the surface was ground down; but the surprising part of the phenomenon is, that if we grind down the external surface with the finest powders, and polish it to the utmost degree, we never can grind out the grooved structure, and replace it by a flat surface. The edges of the shell break off by the action of the finest powders, so that the termination of one stratum cannot pass into the subjacent stratum without being separated by a distinct line or edge, formed by the fracture of its thin marginal parts. As all the strata have thus a prismatic termination, the mass of green and crimson light is reflect-

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ed from near the edge of the surface upon which the superincumbent stratum lies.

Sir John Herschel discovered in very thin plates of mother-of-pearl a pair of nebulous prismatic images more distant from the central image than the two prismatic ones above described, and also a pair of fainter nebulous images, the line joining which is perpendicular to the line joining the first pair. He saw them by looking through thin pieces between the 70th and 300th of an inch thick. They are produced by a veined structure, in which there were 3700 veins in an inch. They cross the common grooves at all angles, and are parallel to the plane passing through the centres of the two systems of the coloured rings.

The spurious discs of stars first noticed by Sir William Herschel, have been justly considered as arising from diffraction, and have been described as supplementary facts to those discovered by Fraunhofer, in Sir John Herschel's *Treatise on Light;* and we believe every thing distinctly known on the subject, is due to the latter. A good telescope with a small power, shews fixed stars as a bright mass of light with some extraneous rays. A magnifying power of from 200 to 400, in favourable weather, exhibits the star as a well defined disc surrounded by several alternately dark and bright equidistant rings slightly coloured at their margin. These rings are best seen in refracting telescopes, with which the central disc is larger than in reflectors.

In applying apertures of various figures to the mirrors and object-glasses of telescopes, Sir John Herschel obtained the following results:

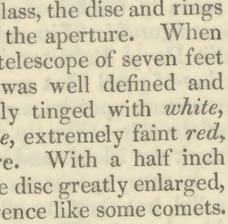
Effects produced by apertures of various shapes.

With the largest circular diaphragm, either near to, or distant from the spectrum or object-glass, the disc and rings increase inversely as the diameter of the aperture. When the aperture was only one inch in a telescope of seven feet in focal length, the disc of the star was well defined and surrounded with one ring only faintly tinged with *white,* faint *red, black,* very faint *blue, white,* extremely faint *red,* and *black,* reckoning from the centre. With a half inch aperture, the rings were invisible, the disc greatly enlarged, the light shading off to the circumference like some comets. This is shewn in fig. 11, Plate CCCLXXXII.

Plate CCCLXXXII. Figs. 11.–22.

With annular apertures the phenomena were highly beautiful. When the outside of the annulus was three inches and the inside one and a quarter, *Capella* appeared as in fig. 12, and the double star *Castor* as in fig. 13. When the breadth of the annular aperture is diminished, the disc and the breadth of the rings also diminish, while the number of visible rings increases. The appearance of Capella with annular apertures of 5·5 inches exterior, 5·5 interior, of 0·7 exterior, of 0·2 interior, and of 2·2 exterior, of 2·0 interior, is represented in figs. 14, 15, and 16. In the last figure the disc was reduced to a point, and the rings were so numerous and close that they could scarcely be counted. When the breadth of this annulus was reduced one-half, the rings were invisible.

Fig. 111.



When two annuli, as shewn in the annexed figure, were used, large halos or rings were seen by Sir John Herschel, as in fig. 17, plate CCCLXXXI.

Fig. 17

With an aperture of the shape of an equilateral triangle, or the opening between two concentric equilateral triangles, the figure was that shewn in fig. 18, in which the small central disc was extremely bright, and the field of the telescope black.

When the preceding figure is seen with the telescope out of focus, it changes into fig. 19.

When three circular apertures are placed at the angles of an equilateral triangle, the effect shewn in fig. 20, is produced.

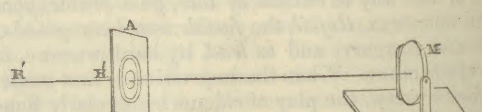
When three equal and similar annular apertures were arranged in the same manner, the effect was as in fig. 12. When this was thrown out of focus, it had the appearance in fig. 21; when brought better into focus, it changed into fig. 22; and when in focus, into fig. 12.[1]

SECT. IV.—*On the Colours of concave Mirrors or thick Plates.*

Colours of thick plates

The colours produced by thick plates were discovered by Sir Isaac Newton, who has given the following account of them.[1] "There is no glass or speculum however well so ever polished but besides the light which it refracts or reflects regularly, scatters every way irregularly a faint light by means of which the polished surface, when illuminated in a dark room by a beam of the sun's light, may be easily seen in all positions of the eye. There are certain phenomena of this scattered light, which, when I first observed them, seemed very strange and surprising to me. The sun shining into my darkened chamber through a hole in the shutter AB, one-third of an inch wide, I let the intromitted beam of light RR fall perpendicularly upon a glass speculum M, ground concave on one side, and convex on the other, to a sphere of five feet and eleven inches radius, and quick-silvered over on the convex side. And holding a white opake chart, or a quire of paper, at the centre of the sphere to which the speculum was ground, that is, at the distance of about five feet and eleven inches from the speculum, in such a manner that the beam of light might pass through a little hole made in the middle of the chart to the speculum, and thence be reflected back to the same hole: I observed upon the chart four or five concentric irises or rings of colours like rainbows, after the manner that those in the fourth and following observations of the first part of this third book encompassed the black spot, but yet larger and fainter than those. If the distance of the chart from the speculum was much greater or much less than that of six feet, the rings became dilute and vanished,

Fig. 112.



The colours of these rainbows succeeded one another from the centre outwards, in the same form and order with those transmitted through the two object glasses.

Measuring the diameters of these rings upon the chart, I found them also in the same proportion to one another with the rings between the two object glasses. For the diameters of the four first of the bright rings measured between the brightest parts of their orbits at the distance of six feet from the speculum, were $1\frac{11}{16}$, $2\frac{3}{8}$, $2\frac{11}{12}$, $3\frac{3}{8}$ inches, whose squares are in arithmetical progression of the numbers 1, 2, 3, 4. If the white circular spot in the middle be reckoned amongst the rings, and its central light, where it seems to be most luminous, be put equipollent to an infinitely little ring; the squares of the diameter of the rings will be in the progression 0, 1, 2, 3, 4, &c. I measured also the diameters of the dark circles between these luminous ones,

[1] Sir John Herschel's *Treatise on Light,* § 769, &c. in which the reader will find the subject more fully treated.

[2] This account is abridged from Newton's Optics, book ii. part iv. p. 264.

riodical olours.

and found their squares in the progression of the numbers $\frac{1}{2}$, $1\frac{1}{2}$, $3\frac{1}{3}$, &c. The diameters of the first four at the distance of six feet from the speculum, being $1\frac{3}{16}$, $2\frac{1}{16}$, $2\frac{2}{3}$, $4\frac{5}{20}$ inches. If the distance of the chart from the speculum was increased or diminished, the diameters of the circles were increased or diminished proportionally.

"When the beam of the sun's light was reflected back from the speculum, not directly to the hole in the window, but to a place a little distant from it, the common centre of that spot, and of all the rings of colours fell in the middle way between the beam of the incident light, and the beam of the reflected light, and by consequence in the centre of the spherical concavity of the speculum, whenever the chart on which the rings of colours fell was placed at that centre. And as the beam of reflected light, by inclining the speculum, receded more and more from the beam of incident light, and from the common centre of the coloured rings between them these rings grew bigger and bigger, and so also did the white round spot, and new rings of colours emerged successively out of their common centre, and the white spot became a white ring encompassing them; and the incident and reflected beams of light always fell upon the opposite parts of this white ring, illuminating its perimeter like two mock suns in the opposite parts of an iris. * *

"The colours of the new rings were in a contrary order to those of the former, and arose after this manner. The white round spot of light in the middle of the rings continued white to the centre, till the distance of the incident and reflected beams at the chart was about $\frac{7}{8}$ parts of an inch, and then it began to grow dark in the middle. And when that distance was about $1\frac{3}{8}$ of an inch, the white spot was become a ring encompassing a dark second spot which in the middle inclined to violet and indigo. * *

"When the distance between the incident and reflected beams of light became a little bigger, there emerged out of the middle of the dark spot after the indigo a blue, and then out of that blue a pale green, and soon after a yellow and red. * *

"When the distance of the two beams of light at the chart was a little more increased, there emerged out of the middle in order after the red, a purple, a blue, a green, a yellow, and a red inclining much to purple." By the successive development of these colours, rings are formed within the white circle till they become very dilute and vanished while the white ring, and one or two on each side of it, continued visible; and these also vanished when the distance between the two beams of light was still more increased.

"These are the phenomena," says Sir Isaac, "of thick convexo-concave plates of glass, which are everywhere of the same thickness. There are yet other phenomena when these plates are a little thicker on one side than on the other, and others when the plates are more or less concave than convex, or plano-convex, or double convex. For in all these cases the plates make rings of colours, but after various manners."

The Duke de Chaulnes[1] observed colours analogous to those of thin plates, when the surface of a mirror was covered with a thin film of milk after it was dry, or with a screen of gauze or muslin placed at a small distance in front of the mirror. Sir Wm. Herschel[2] has given an account of an interesting experiment in which, by dispersing hair-powder in the air before a metallic speculum on which a beam of light is incident, and receiving the reflected beam on a screen, fine rings of colour are produced; or an analogous phenomena may be seen by scattering hair-powder on the face of a common looking-glass.[3]

Sir David Brewster has remarked,[4] that the method which he has found the most simple for exhibiting these colours, is to place the eye immediately behind a small flame, from a minute wick fed with oil or wax, so that we can examine them even at a perpendicular incidence. The colours of thick plates may be seen even with a common candle held before the eye at the distance of ten or twelve feet from a common pane of crown glass in a window that has accumulated a little fine dust upon its surface, or that has on its surface a deposition of fine moisture. Under these circumstances they are so very bright, that they may be seen even when the pane of glass is clean.

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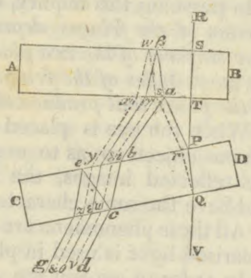
SECT. V.—*On the Colours produced by Double Plates of Glass of equal thickness.*

Colours of double plates of equal thickness.

In 1815, Sir David Brewster published in the Edinburgh Transactions[5] "An account of a new species of coloured fringes produced by the reflection of light between two plates of parallel glass of equal thickness."

In these experiments he cut the plates of glass AB, CD, fig. 112, out of the same piece, and having placed between them a bit of soft bees' wax, he pressed them together till they were at the distance of nearly the tenth of an inch, and slightly inclined to each other as in the figure, till one or more of the reflected images of a circular luminous disc seen in the direction VR by an eye at V, were reflected from the bright and direct image formed by transmitted light. When this was done the reflected image was crossed with about fifteen or sixteen beautiful parallel fringes. The three central fringes consist of blackish and whitish stripes, and the exterior ones of brilliant stripes of red and green light; and the central fringes have the same appearance in relation to the external fringes, as the internal have to the external rings formed by thin plates. If the two plates of glass are turned round in a plane at right angles to the incident ray, the reflected images will move round the bright image, and the parallel fringes will always preserve a direction at right angles to a line joining the centres of the bright and reflected images. Hence it follows, *that the direction of the fringes is always parallel to the common section of the four reflecting surfaces, which exercise an action upon the incident light.*

Fig. 113.



The position of the plates remaining as before, let the inclination of the plates, or, what is the same thing, the distance of the bright and the reflected image, be varied by a gentle motion of one of the plates, *the coloured fringes will be found to increase in breadth as the inclination of the plates is diminished, and to diminish as the inclination of the plates is increased.*

If the light of the circular object, instead of falling perpendicularly upon the plates, is incident at different obliquities, so that the plane of incidence is *at right angles to the common section of the plates,* no fringes are visible across any of the images. But if the plane of incidence is *parallel to the common section of the plates,* the reflected images increase in brightness with the obliquity of incidence, and the coloured fringes become more vivid. When

[1] *Mém. de l'Acad. de Paris,* 1705, p. 136.
[2] *Phil. Trans.* 1807, Part ii.
[3] See our Article CHROMATICS, vol. vi. p. 639. sect. ix.
[4] *Treatise on Optics,* Lardner's *Cyclop.* § 77.
[5] Vol. vii. p. 435.

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the angle of incidence increases from 0° to 90°, the images that have suffered the greatest number of reflections are crossed by other fringes, inclined to them at a small angle. At an angle of about 44°, the image formed by four reflexions is covered with interfering fringes; but it is not till the angle of incidence is greater, that this is distinctly seen on the image formed by two reflexions.

Hitherto he had observed no fringes upon the first or bright image, which is composed of light that has not suffered reflexion from the second plate of glass. By concealing, however, the bright light of the first image, so as to perceive the image formed by a *second* reflexion, within the first plate, and by viewing this image through a small aperture, which he found of great service in giving distinctness to all the phenomena, he observed fringes across the first image, far surpassing in precision of outline, and in richness of colouring, every analogous phenomenon which he had seen. When these fringes were concealed, he also observed other fringes on the image immediately behind them, and formed by a *third* reflexion, from the interior of the first plate. He concealed the second image, upon which the fringes were extremely bright, and very faint stripes were seen upon the one immediately behind it.

In examining these phenomena a little more attentively, he observed that the size of the fringes in the first image varied with the distance of the eye from the plates, while those on the second and fourth image diminished with that distance.

In pursuing this inquiry, our author found *that the production of the fringes depends upon the action of all the four surfaces of the two plates of parallel glass; and that the magnitudes of the fringes are inversely as the thickness of the plates that produce them at a given inclination.*

When the eye is placed between the plates and the luminous object, so as to see the *first, third, fifth, seventh,* &c. reflected images, the coloured fringes are also seen, and have the same character as those already described.

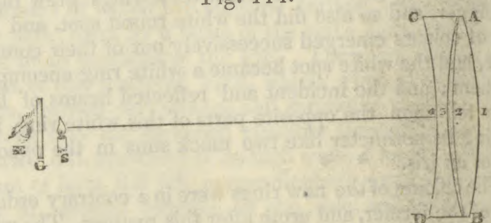
All these phenomena are seen without any variation when polarised light is used in place of common light.

In order to explain the changes which the light undergoes in its passage through the plates of glass, let AB, CD, fig. 113, be a section of two plates at right angles to the common section of their surfaces, and let RS be a ray of light incident nearly in a vertical direction. This ray, after passing through the first plate AB, will suffer a small refraction at P and Q, and emerge in the direction QV parallel to RS. At the point P, in the second plate CD, the ray TP will be reflected to a, again reflected to b, and, after suffering a refraction at b and c, will emerge in the direction cd, forming with RV an angle equal to twice the inclination of the plates. A portion of the reflected ray Pa, will enter the first plate at a, and having suffered reflexion and refraction at β, the reflected portion $\beta\gamma$ will reach the eye at θ. The ray P $a\ b\ c$ will likewise suffer a reflection at c and e, and will reach the eye at g. In like manner, a part of the ray PQ will be reflected at Q, and move in the direction Q$r\,s\,t\,u\,v$, and another part of it in the direction $s\,w\,x\,y\,z$, and these rays will suffer several other reflexions; but the images which they form will be so faint, that the eye will not be capable of perceiving them. When the observer, therefore, looks at a luminous body, in the direction SR, through the glass plates, he will perceive two images, one of which is a bright image, seen by the transmitted light QV, and the other is a faint image, seen principally by the reflected light P $a\ b\ c\ d$ and composed of several images, formed by the pencils $c\,d$, $u\,v$, $\epsilon\,\theta$, z &, and $e\,g$. The bright image is not crossed by coloured fringes, but the fringes appear distinctly upon the other image; and the light by which these fringes are formed, has suffered two reflexions from the exterior surfaces, and two refractions at the interior surfaces of the plates."

Dr. Thomas Young, in the article CHROMATICS in this work,[1] has given an explanation of these phenomena upon the principles of interference, and Sir John Herschel has shewn by an interesting analysis of them, that they are well fitted for illustrating the laws of this class of phenomena, and may be readily explained by interference.[2]

When two or three plates are combined, as in the form of concave and convex lenses, and are combined as in the double and triple achromatic object-glass, a series of beautiful systems of rings are developed. The method of observing these rings, and by which Sir David Brewster discovered them, is shewn in fig. 114, where ABCD is the section of the object-

Fig. 114.



glass, including a meniscus of air. A small flame S, is placed about four or five inches from the object-glass, and a small screen G, is interposed between the flame and the eye at E, which is kept as close to S as possible. The distance of the object-glass is then varied, till the inverted greenish coloured flame reflected interiorly from the concave surface A 1 B, seems to cover the whole area of the object-glass. When this takes place, the rings may, by a slight change in the position of the object-glass, or by screening the image formed by the reflection from A and B, be seen in the distinctest manner over the expanded but enfeebled image formed by a second reflexion from the same surface.

When the flame is small, and the eye sees it projected against the centre of the object-glass, the rings form a concentric system, as shewn in fig. 23, Plate CCCLXXXIII, approaching closer and closer to each other, towards the circumference of the lens. Two of these rings *mmmm, n, n, n, n,* were distinguished from the rest by their darkness, and by the whiteness of the light between them; and they are the bounding lines of four systems of fringes, into which the general system subdivides itself by oblique reflection; in order to see this change, incline the object-glass so that the point A is farther from the eye than B, and so that the eye may receive the obliquely reflected rays from every point of the surface A and B. At a slight deviation from the perpendicular, the rings become smaller and closer on the side A, and larger and more separated on the side B. At greater incidences the inner ring *aa*, fig. 23, contracts into an irregular crescent *aa*, fig. 24. The second and third rings *bbcc*, fig. 23, do the same, as shewn at *bbcc*, fig. 24; and at a greater incidence the dark ring *nn*, fig. 23, assumes a similar form *nnnn*, fig. 24, and forms the boundary of the *remote central system, ncbaabcn.* In like manner the lower part of the ring *nn*, fig. 23, has enclosed a smaller but similar system of rings, which are shewn at *n'n'n'n'*, and may be called the *near central system.* While these changes are going on, the rings without *nn*, fig. 23, are undergoing analogous, though opposite, inflexions. The outermost, *ddd*, fig. 23, divides itself into two unequal portions, which run out into the circumference at the points

[1] Vol. vi. p. 636, sect. vi.

[2] *Treatise on Light*, § 688—696. See also Biot's *Traité de Physique*, tom. iv. p. 246.

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$dd\acute{d}d'$, fig. 24. Then the next ring, viz. the dark one, m, m, m, m, forming the boundary of the *remote external system*, m, m, m, A, and of the *near central system* m', m', m', B. The four groups of rings thus developed, assume at greater incidences the character shewn in fig. 25, but they are not seen all at once; and in tracing their form it is necessary to cause the image on which they are produced to be reflected successively from different parts of the lens. The rings are so closely packed together, at a distance from the white centres $x'x$, to which they are all related, that it is extremely difficult to perceive them in the present object-glass. At a still greater angle of incidence, the rays close in upon the centres $x'x$, and become exceedingly close and nearer as the points $x'x$ approach to the circumference of the lens, and the rays become brighter from the increase of the light at greater obliquities.

Plate CCCLXXXIII. Fig. 24. Fig. 25.

In some double object-glasses the rays can only be seen by looking through the convex crown glass lens. In one object-glass the four bounding fringes at xx, fig. 25, united and formed a black cross, as shewn in fig. 26. From a series of experiments Sir David Brewster has found that in the object-glass shewn in fig. 113, the action of the two surfaces 1, 2 of the convex lens AB, and the inner surface 3 of the concave one CD, are necessary to the production of these fringes, and hence he concludes that the rings arise from the interference of two pencils of light, one of which has suffered *three* reflections within the convex lens AB, and has passed *four* times through its thickness, with another pencil which has suffered *two* reflexions within the convex lens, and *one* reflexion from the inner surface of the concave lens, and has passed *four* times through the thickness of the convex lens, and *twice* through the thickness of the meniscus of air.

Fig. 26.

In a triple object-glass, which gave a system of rings similar to that in fig. 26, they were covered with *another system of very minute fringes*, parallel to one another, and to the line joining the centres x and x.[1]

Sect. VI.—*On the Colours of Double Plates of Glass of Unequal Thickness, and other Analogous Phenomena.*

Colours of Double Plates of Equal Thickness.

Mr. W. Nicholson observed the colours of thick plates in the glasses employed for the sights of sextants, and he considered them analogous to those of thin plates. They have been ascribed, however, by Dr. Young,[2] "to the rays twice reflected in the second plate only."

Knox.

Mr. Knox of Belfast[3] has described some interesting phenomena already briefly noticed by Dr. Young, in the article Chromatics. Having formed a system of the rings of thin plates, by placing a convex lens on a piece of silvered glass, he observed the common system of reflected rings, and also the transmitted system reflected to his eye by the silvered glass. This is shewn in fig. 27, Plate CCCLXXXIII. where A and B are the two systems; but he was surprised to observe between them a system of parallel fringes CD EF, passing through the intersection of the two circular systems. These fringes were equal in number to the number of the rings in A and B. They were equidistant, reached the edge of the lens on both sides, and were formed at right angles to the direction of the light, and to a line forming the centres of the systems A and B.

Fig. 27.

Our author then tried the effect of combining two primary systems of reflected rings in the same manner. With this view he placed a double-convex lens about thirty-six inches in focal length, on a piece of plate glass, with its under side painted black, and upon the lens he placed a piece of plate glass. By these means two sets of primary rings were produced, whose relative positions could be altered at pleasure. By using the shadow of a black card, he found that, instead of parallel fringes, as in fig. 27, he had a new species of rings of a circular form, from two to three times the diameter of the primary rings from which they originated. These rings passed, as before, through the intersections of the primary ones; and the ring which divided the two classes passed through a point, whose distance from the centre of each primary set were in proportion to their longest diameters.

These rings, which Mr. Knox calls *intersectionary* ones, may be made to vary infinitely in their dimensions, according as the diameters of the primary sets differ more or less, being least where that difference is greatest, and increasing in size as the two primary sets approach to equality, until at last they become straight lines, when the two primary sets are equal. The dimensions of the intersectionary rings will also, as Mr. Knox remarks, *ceteris paribus*, diminish as the two primary sets approach, and increase as they recede from one another.

As these intersectionary rings are almost always accompanied by a second, and sometimes by a third set of equal or unequal dimensions, Mr. Knox supposes that they may be produced by primary sets, combined with either transmitted or reflected sets, provided the two between which they are formed are of unequal dimensions.

Considering the intersectionary fringes as diagonals to the angles at which they were formed, Mr. Knox conjectured that if he could form rectilineal fringes by flat plates, and combine them at different angles, he would produce a third or diagonal set placed between the other two. He accordingly took a pair of slips of glass, and by applying two of their ends together, and using some friction, and a considerable degree of pressure, he formed a fine set of rectilineal fringes. By applying a third slip of glass longitudinally to the upper one of the first two, he formed a similar set of rectilineal fringes at right angles to the first; and he immediately observed the diagonal fringes, which he had anticipated, appear in the angle between the two primary sets, as shewn in fig. 28, where B and C are the primary fringes, and D the intersectionary set, divided into two classes, as shewn by the dotted line. By forming the second set of fringes at different angles with the first, the central band of the intersectionary fringes always bisected the angle. It is a curious circumstance, that though the diagonal fringes are formed by the crossing of the two primary sets, yet they never appear at the opposite angle A, nor could they be made to appear in any angle formed by primary fringes, unless these fringes were so disposed as to have their red sides turned towards each other.

Plate CCCLXXXIII. Fig. 28.

Dr. Young has given an explanation of these curious phenomena in the article Chromatics,[4] to which we must refer the reader.

Dr. Young

Mr. Henry Fox Talbot upon superposing two films of blown glass and viewing through them a homogeneous yellow flame, and even the light of the sky, observed bright and dark stripes, or coloured bands and fringes, which were not produced by either of them separately. These phenomena, as Sir John Herschel remarks, are obviously referable to the same principle as the fringes discovered by Sir David Brewster, "the interference taking place here between rays respectively twice reflected within the upper lamina, and once reflected at the upper surface of the lower lamina, or else between rays, one of which is thrice reflected in the mode represented by $AaB'a'B'aA$, and the other in that represented by $AaB'aA'a'A$, the interval between the glasses being supposed to be exactly equal to the

Mr. Fox Talbot.

[1] *Edinburgh Transactions*, vol. xii. p. 191. [2] Art. Chromatics. vol. vi. p. 636. [3] *Phil. Trans.* 1815, p. 161. [4] Vol. vi. p. 636.

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thickness of the upper one in both cases, a condition which is sure to obtain somewhere when the laminæ are curved."[1]

Sect. VII.—*On the Colours of Fibres formed by Reflexion and Transmission.*

Colours of fibres.

Every person must have observed the fine thread or line of the spider's web glittering with the brightest colours, when the light of the sun is reflected from it to the eye. By examining these colours attentively, they are found to vary with the angle of incidence. The only attempt that we know of to explain this phenomenon, that deserves notice, is that of Sir John Herschel:—"These colours," says he, "may arise either from a similar cause, (namely, that which produces colour in a single scratch or fissure, or the interference of light reflected from its opposite edges,) or from the thread itself as spun by the animal, consisting of several agglutinated together, and thus presenting not a cylindrical but a furrowed surface." That the structure thus assumed would produce colours cannot be doubted, but they would be the colours of grooved surfaces such as we have already described, which we conceive to be exceedingly different from those of the spider's line.

It appears from a preceding section, that when a reflecting surface has its breadth reduced to an extreme degree of narrowness, whether it be a metallic or a transparent one, it is no longer capable of reflecting white light, but decomposes it in the manner already described, the coloured bands being transverse to the direction of the reflecting line. Sir David Brewster has therefore applied this new property of reflecting surfaces to account for the colour of the spider's line, which presents analogous phenomena, and which from its extreme minuteness, must necessarily decompose white light. If this is not the true cause of the phenomenon, it will not be easy to obtain any rational explanation from the doctrine of interference, without taking for granted the existence of a structure of a very peculiar kind.

On the Colours of Fibres by transmitted Light.

If we take a number of fibres of wool, and fix them in parallel directions, as in Fraunhofer's gratings, they would of course produce parallel spectra or coloured bands similar to those already described. If we take a mass of the same wool, in which the fibres have every possible direction, they will then exhibit spectra or fringes lying in every possible direction, or circular ones. As both these results would be equally obtained, if the fibres were cut down into particles as long as they are broad, we should have parallel fringes when the particles are arranged in straight lines, and circular ones when the particles are scattered like dust upon a plate of glass in all directions. Hence fibres of minute particles will produce circular fringes, which increase in diameter as the particles are smaller in diameter.

When we therefore look at a candle placed at a little distance, through wool, or cotton, or vapour lying upon glass, or diluted blood, or milk, or the seed and farina of plants, &c. &c., we observe round the image of the candle a light area terminating in a *dark reddish* margin. This is followed by a ring of *bluish green* light, and then a *red* ring, and when the fibres or particles have an uniform size, the green and red rings are frequently repeated. It is to Dr. Young that we owe the discovery that the diameter of these rings is always the same when the size of the particles or fibres is uniform and equal, and that they vary inversely as the size of the fibres or particles. On this principle he constructed his *eriometer* for measuring the diameter of minute particles and fibres, such as *wool*, &c. It is composed of a plate of brass, or copper, or even card, with an aperture in the centre about the fortieth of an inch in diameter, and surrounded by a circle of perforations about half an inch in diameter, the number of perforations in the circle being about ten or twelve, and as minute as possible. When the instrument is constructed on such a small scale, the eye requires the aid of a lens. The wool, or plate of particles, are then attached to the end of a slider, and when the light of an argand lamp, or two or three candles placed in a line, so as to unite their flames, is transmitted through the wool or particles, the slider is drawn out till the first *dark red* coloured circle coincides with the circle of particles, and the index then shews on the scale upon the slider the number which indicates the size of the fibres or particles. The basis of this scale, rather an imperfect one, Dr. Young took from Dr. Wollaston's measure of the magnitude of the seeds of the *puff ball* or *Lycoperdon bovista*, which he found to be the 8500ths of an inch in diameter. Dr. Young found the rings formed by these minute seeds to be three-and-a-half on the scale of his instrument, and hence he assumes the *thirty thousandth* part of an inch, (more accurately the 29750th), as the value of an unit on his scale. The following results were obtained by Dr. Young:—

Dr. Young's eriometer.

Table of the diameter of Fibres and minute particles.

Milk diluted, very indistinct, about	3
Lycoperdon bovista, dust of, very distinct	3½
Blood of a bullock, from beef	4½
Human blood, diluted with water	5
Smut of barley (male ear)	6½
Blood of a mare	6½
Human blood diluted with water after standing five days	6½
Blood recently diluted with serum, only	8
Pus	7½
Silk, very irregular	12
Wool of the beaver, jointed, very uniform	13
Angola wool, about	14
Vigonia wool	15
Siberian hare's wool, Scotch hare's wool, foreign coney wool, yellow rabbit's wool, about	15½
Mole's fur	16
Skate's blood	16
British coney wool, American rabbit's wool, about	16½
Saxon wool, a few fine fibres	17
Buffalo's wool	18
Wool of the mountain sheep, *ovis montana*	18
Seal wool, finest, mixed, about	18½
Shawl wool	18 or 19
Goat's wool	19
Cotton, very unequal	19
Peruvian wool, mixed, the finest locks	20
Welch wool, a small lock of	20
Saxon wool	23 or 24
Wool of an Escurial ram	23 to 24
Southdown wool	24½
Lioneza wool, 24 to 29	generally 25
Paular wool, 24 to 29	generally 25½
Alpacca wool, about	26
Laurestinus, farina of	26
Ryeland merino wool	27
Merino Southdown wool	28
Lycopodium seed, beautifully distinct	32
Southdown ewe wool	39
Coarse wool, Sussex	46
Coarse wool, from same, worsted	60

The diameter of the fibres or particles in the preceding table may be obtained in parts of an inch, by dividing the $\frac{1}{30,000}$ of an inch by the numbers opposite them. The diameter of the particles of the human blood will be

[1] *Treatise on Light*, § 693. See also *Biot, Traité de Physique*, tom. iv. p. 246.

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$\frac{1}{30,000}$ divided by 5, or the 6000th part of an inch. Dr. Young has ingeniously observed, that if we square the number belonging to the pound of wool, and substract 325, the remainder will be nearly the number of pounds of wool that are worth 100 guineas. In the case of good Lioneza wool for example, whose number is 25, we shall have $25 \times 25 - 325 = 300$ for 100 guineas, or seven shillings per pound.[1]

In experiments of this kind it would be better to express the magnitude of the first ring in parts of the radius, or by the angle which the whole ring subtends at the eye. Those who have any of Mr. Barton's scales, with the number of lines in an inch marked, can easily compare the diameter of the first ring produced either by fibres or particles, with the distance of the red spaces in the two first prismatic images; and by the rule of proportion he will find the magnitude of the fibres or particles.

Sect. VIII.—*On the colours of mixed plates.*

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The phenomena of colour observed by M. Mazeas, when he pressed between two glasses, suet, Spanish wax, resin, common wax, and the sediment of urine, are *clearly those of mixed plates*, though they have not hitherto been recognised as such. He put between his glass plates a little ball of suet about one-fourth of a line in diameter, and pressed it between the two surfaces, warming them at the same time in order to disperse the suet. He then rubbed them violently together in a circular manner, and was surprised at looking at a candle through them to see it surrounded with two or three concentric rings, very broad, and with very lively and delicate colours, namely, a red inclining to yellow, and a *green* like that of an emerald. By continuing the friction, the rings assumed the colours of *blue*, *yellow*, and *violet*, especially when he looked through the glasses on bodies directly opposed to the sun.

M. Mazeas[2] shews very clearly that these were not the colours of thin plates on account of the distance between the glasses, and also because the colours disappeared by melting the suet, but a new species of colours which he tried in vain to explain.

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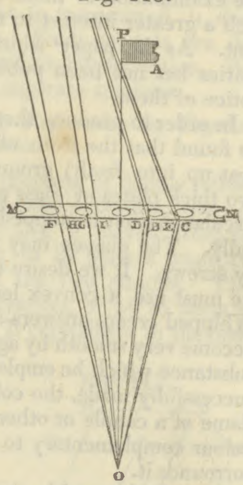
M. Dutour[3] repeated and varied the experiments of Mazeas, but did not succeed in explaining them.

oung.

Dr. Thomas Young, apparently without knowing of the experiments of Mazeas, though they are fully detailed by Priestley, has described the very same colours under the name of the *colours of mixed plates*, and the merit of discovery of these colours has been ascribed to him by almost all modern writers. The method of producing the colours by suet, as given above by Mazeas, is exceedingly simple, while many persons have failed in repeating the experiments described by Dr. Young. It is to Dr. Young, however, that we owe the higher obligation of having discovered the general principle to which these colours must be referred, though he has not examined the phenomena with that attention which they merited. The following is the account which Dr. Young has given of the colours of mixed plates.

"I first noticed the colours of mixed plates, in looking at a candle through two pieces of plate glass, with a little moisture between them. I observed an appearance of fringes resembling the common colours of thin plates; and, upon looking for the fringes by reflection, I found that these new fringes were always in the same direction as the other fringes, but many times larger. By examining the glasses with a magnifier, I perceived that wherever these fringes were visible, the moisture was intermixed with portions of air, producing an appearance similar to dew. I then supposed that the origin of the colours was the same as that of the colours of halos; but, on a more minute examination, I found that the magnitude of the portions of air and water was by no means uniform, and that the explanation was therefore inadmissible. It was, however, easy to find two portions of light sufficient for the production of these fringes; for the light transmitted through the water, moving in it with a velocity different from that of the light passing through the interstices filled only with air, the two portions would interfere with each other, and produce effects of colour according to the general law. The ratio of the velocities, in water and in air, is that of 3 to 4; the fringes ought therefore to appear where the thickness is 6 times as great as that which corresponds to the same colour in the common case of thin plates; and, upon making the experiment with a plain glass and a lens slightly convex, I found the sixth dark circle actually of the same diameter as the first in the new fringes. The colours are also very easily produced, when butter or tallow is substituted for water; and the rings then become smaller, on account of the greater refractive density of the oils; but, when water is added, so as to fill up the interstices of the oil, the rings are very much enlarged; for here the difference only of the velocities in water and in oil is to be considered, and this is much smaller than the difference between air and water. It appears to be necessary for the production of these colours, that the glasses he held nearly in a right line between the eye and the common termination of a dark and luminous object; the portion of the rings, seen on the dark ground, is then more distinct than the remaining portion; and, instead of being continuations of the rings, they exhibit every where opposite colours, so as to resemble the colours of common thin plates seen by reflection, and not by transmission. In order to understand this circumstance, we must consider that where a dark object as A is placed behind the glasses, the whole of the light which comes to the eye, is either refracted through the edges of the drops, (as the rays B, C,) or reflected from the internal surface (as D, E,) while the light which passes through those parts of the glasses which are on the side opposite to the dark object, consists of rays refracted as before through the edges, (as F, G,) or simply passing through the fluid, (as H, I.) The respective combinations of these portions of light exhibit a series of colours of different orders, since the internal reflection modifies the interference of the rays on the dark side of the object, in the same manner as in the common colours of thin plates seen by reflection. When no dark object is near, both these series of colours are produced at once; and since they are always of an opposite nature at any given thickness of a plate, they neutralize each other, and constitute white light.

Fig. 115.



In applying the general law of interference to these colours, as well as to those of thin plates already known, it is impossible to avoid a supposition which is a part of the undulatory theory, that is, that the velocity of light is the greater, the rarer the medium; and there is also a condition annexed to this explanation of the colours of mixed plates, as well as to that of the colours of simple thin plates, which involves another part of the same theory; that is,

[1] See Dr. Young's Introduction to Medical Literature, p. 552.
[2] *Memoires Presentées*, tom. ii. p. 43.
[3] Id. Id. tom. iv. p. 288, 289; or Priestley *On Vision*, vol. ii. p. 505.

Periodical Colours.

that where one of the portions of light has been reflected at the surface of a rarer medium, it must be supposed to be retarded one half of the appropriate interval; for instance, in the central black spot of a soap bubble, where the actual lengths of the paths very nearly coincide, but the effect is the same as if one of the portions had been so retarded as to destroy the other. From considering the nature of this circumstance, I ventured to predict, that if the two reflections were of the same kind, made at the surfaces of a thin plate of a density intermediate between the densities of the mediums containing it, the effect would be reversed, and the central spot, instead of black would become white; and I have now the pleasure of stating, that I have fully verified this conclusion by interposing a drop of oil of sassafras between a prism of flint-glass and a lens of crown-glass; the central spot seen by reflected light was white, and surrounded by a dark ring. It was however necessary to use some force, in order to produce a contact sufficiently intimate; and the white spot differed, even at last, in the same degree from perfect whiteness, as the black spot usually does from perfect blackness. There are also some irregularities attending the phenomena exhibited in this manner by different refracting substances, especially when the reflexion is total, which deserves farther investigation."

Recent experiments.

We are not aware that these interesting experiments of Mazeas and Dr. Young, have been repeated by any modern writer, our treatises on optics containing merely an abstract of Dr. Young's results. The subject has, however, been recently taken up by Sir David Brewster, who had found that the *colours of mixed plates*, in place of being merely the result of an experiment, was a *natural phenomenon* of a very interesting kind, which frequently presented itself in the examination of minerals. He was therefore led to attach a greater interest to the phenomena which they present. As the paper[1] which contains the results of his inquiries has not been published, we can only give a brief notice of them.

In order to produce these colours so as to be permanent, he found that the froth of albumen, (the white of an egg beat up into froth) ground circularly as it were between two thick plates of glass pressed firmly together, when the circular motion is stopped, exhibits the colours very splendidly. The glasses may then be held together by wax or by screws. If we desire to have a circular system of rings, we must use a convex lens in place of one of the plates. Whipped cream answers also very well; but paste that has become very smooth by age he found preferable to any other substance which he employed. When the experiment is successfully made, the colours are extremely splendid, the flame of a candle or other luminous body being of a bright colour complementary to that of the coloured light which surrounds it.

Upon looking with a microscope at the albumen or paste thus pressed into a film, it is found to resemble accurately the strata of cavities containing the new fluids, and sometimes water, as in *sulphate of lime*, &c., the paste being sometimes found in separate ramified patches of all shapes surrounded with air, while on some occasions numerous air cavities are included in the paste.

Although Dr. Young was correct in ascribing the colours of mixed plates to the interference of rays moving with different velocities in passing through the two contiguous media, yet his analysis of the phenomena is imperfect, and his determination of the interfering pencils incorrect. In his 39th lecture he ascribes "the colours seen in the dark part beyond the object, to the light scattered irregularly from the surfaces of the fluid,"[2] and in his description of fig. 115, above quoted, he specifies as the interfering portions which produce the colours, viz. *rays reflected* from the internal surface of the cavities, with *rays refracted* through the edges of the drops; and *rays refracted* through the edge with rays *simply passing* through the fluid. That the colours of mixed plates are not produced either by refracted or reflected pencils, is at once proved by the fact, that the same colours may be produced when the most refracting medium is terminated by a fine edge, and is itself a plate with perfectly parallel surfaces, so that there is no edge to reflect light, and no inclined faces to refract it. Having obtained this result, Sir David Brewster viewed the subject in another aspect, and has shewn that the phenomenon is entirely one of inflexion caused by the edge of a transparent inflecting body sufficiently thin to produce colours by the interference of the retarded light passing through the body close to its edge, with the light passing within the body close to its edge. The same pencils which interfere in the common case of a diffracting body interfere in the present case; but the pencils that pass through the transparent plate are modified by the retardation which they experience, so as to produce the phenomena of colours. The oppositely coloured pencils in mixed plates form part of the system of diffracted fringes, the colour seen upon the luminous body occupying the shadow of the diffracting edge, and the opposite colour seen around or beside the candle occupying the first fringe on each side of the shadow. The colours in the fringe on the left hand of the shadow of the diffracting edge, are seen by the eye on the right hand side of the candle, and those in the fringe on the right hand of the shadow are seen by the eye on the left hand side of the candle.

All the preceding phenomena may be produced by breaking down a thin transparent plate into minute portions, and when these portions are made to float in a fluid, or are placed between two plates of glass containing a fluid of nearly the same refractive power as the solid portions. The solid portions will thus act like much thinner plates placed in air, and we shall observe the identical phenomena which take place with the cavities in paste or albumen. When we examine with the microscope a very narrow portion of the solid substance bounded by lines nearly parallel, we perceive the phenomena of mixed plates under a new aspect. The space between the shadow of the two edges is filled up with a bright band of the colour which occupies the two first external fringes, and as the innermost fringe of each edge overlap each other, the colour has double the intensity. The same phenomenon is often seen in the parallel ramifications, or in the long cavities produced by the paste or albumen when the last act of friction was to move one of the plates of glass in a straight line.

The phenomena of mixed plates have been discovered by Sir David Brewster in *sulphate of lime*, in which there are shallow crystallised cavities in great numbers forming regular strata in the mineral. These cavities are filled with water, and in this case the diffracting edge is the edge of the cavity, and the light which passes through the water has its velocity greater than that which passes through the solid mineral.

In one remarkable circular stratum of cavities, all the cavities in the centre were the deepest, and gradually diminished in depth towards the circumference, till the microscope could scarcely resolve them. The highest orders of colours were therefore in the middle of the stratum, and they gradually descended to a white of the first order, at the circumference of the circular stratum.

An interesting experiment lately published by Henry Fox Talbot, Esq.[3] is a phenomenon of mixed plates, in which the densest of the plates is too thick to produce the colours at its edge in common light. "Make," says he, "a circular hole in a piece of card, of the size of the pupil

[1] This paper will probably appear in the *Phil. Trans.* for 1838, part i.
[2] *Elements of Natural Philosophy*, vol. i. p. 470. [3] *Lond. and Ed. Phil. Mag.* May 1837, p. 364.

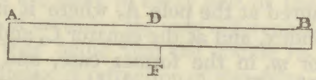
Double Refraction.

of the eye. Cover one half of this opening with an extremely thin film of glass (probably mica would answer the purpose as well or better.) Then view through this aperture a perfect spectrum formed by a prism of moderate dispersive power, and the spectrum will appear covered throughout its length with parallel obscure bands resembling the absorptions produced by iodine vapour. The cause of this phenomenon probably is, that one half of the light which passes through the glass film has its undulations thereby retarded by a certain quantity."

This phenomenon, which we have observed under various modifications, arises from the diffraction of the light passing on each side of and very close to the edge of the film; for if we cover this edge even with a fine wire, we obstruct the diffracted fringes modified by the retardation of the denser plate, and the phenomenon vanishes. Hence in order to see the fringes in perfection, we must make the aperture no wider than to include the space on each side of the edge of the film within which the light passes that is concerned in the phenomenon. As the light here used is perfectly homogeneous, the bands are alternately coloured and obscure.

Sir David Brewster has observed the fringes described by Mr. Talbot with thick plates having fine edges, and immersed in fluids, and even with plates of glass the 15th part of an inch thick, by looking through their edge upon a highly dispersed spectrum formed by a large refracting angle of a prism, and magnified by a powerful telescope. The perfection of the edge of the film, and an equality of thickness, are essential to the production of the fringes in their most interesting form. Sir David Brewster obtained them by looking through plates of sulphate of lime, where there were not properly speaking plates of different refractive powers, but where the plate suddenly became thicker, as shewn in the annexed figure, where AB, EC is the plate of sulphate of lime, which becomes thicker at E. When the eye looks through it at the spectrum in the direction ED, it sees the fringes which have the same magnitude as if the plate ADB were removed, and the eye looked only through the plate CE, in which case it is clearly a phenomenon of mixed plates.

Fig. 116.



When these dark lines were produced in great perfection, they had a sort of granular structure resembling fine screws at their edges, and sometimes appearing to enclose minute specks of light. Several other remarkable phenomena accompanying these fringes were communicated by the author to the British Association at Liverpool, and will appear in the next volume of the Philosophical Transactions.

PART. VI.—ON THE DOUBLE REFRACTION OF LIGHT.

Double refraction.

In the preceding part of this article we have supposed that when light is transmitted vertically through the surfaces or through the mass of transparent bodies, or when it passes obliquely and is refracted by the same bodies, it leaves the surface or emerges from the body in a single pencil, either perfectly white, or decomposed into a diverging beam of coloured light. This supposition is perfectly correct, under certain circumstances, for gaseous and fluid bodies, for glass slowly and equally cooled, and for a numerous class of crystallized bodies, whose primitive form is either the *cube*, the *regular octohedron*, or the *rhomboidal dedecahedron*. When these bodies have the same temperature and density throughout their mass, and are not exposed to any pressure, a pencil of light will be transmitted through them *single*, according to the laws already explained.

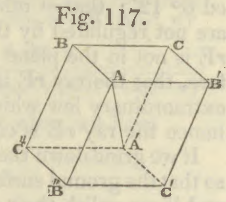
When a pencil of light falls upon all other bodies, such as artificial crystals, or salts on crystallized minerals, which have not the above primitive forms; upon animal substances, such as bone, horn, shell, hair, crystalline lenses of animal and elastic integuments; upon vegetable bodies, such as particular leaves, stalks and seeds; upon artificial bodies such as gums, resins, jellies, and solid bodies that have a variable density, during the transient passage of heat, or from rapid cooling, or unequal temperature and pressure:—when a pencil of light falls upon such bodies, it will be refracted into two distinct pencils, more or less inclined to each other according to the mechanical condition of the body, or to the direction in which the pencil passes through it. In some minerals and artificial crystals, this refraction of the two pencils is very great, and, generally speaking, is in such crystals, easily observed and measured; but in some cases it is not visible unless by transmitting the light through prisms of the body with large refracting angles; and in very many cases, the existence of two pencils is inferred only from certain other properties, which always accompany the property of giving double pencils. This separation of a single pencil into two, is called *double refraction*, and the bodies which have such a property are called *doubly refracting crystals* or *bodies*.

In many regular crystals there is *one line* through which, if a single pencil of light is transmitted, it does not experience double refraction. This line is called the *axis of the crystal*, or the *axis of double refraction*, and such crystals are denominated crystals with one axis of double refraction. In other crystals there are two lines through which, if the single pencil of light is transmitted, it does not experience double refraction. Such crystals are denominated crystals with two axes of double refraction. We shall treat of these two classes in separate sections.

SECT. I.—*On the Law of Double Refraction in Crystals with one Axis.*

As Bartholinus discovered the property of double refraction in the mineral called *Iceland spar*, *calcarcous spar*, or by chemists, *carbonate of lime*; and it is well fitted for exhibiting the phenomena, owing to its perfect transparency, and the great separation of the two pencils. This mineral consists, according to Stromeyer, of 56·15 parts of lime, and 43·7 of carbonic acid. It crystallises in the form of an obtuse rhombohedron, as shewn in fig. 117, where ABCB, ABCB, &c. are the faces of the rhombohedron, and AA′, the axis of the rhombohedron, on the two joining its two obtuse angles. The following are the dimensions of the crystal, as given by Malus, who observes that the first angle, from which all the rest are derived, is within *ten seconds* of the truth.

Fig. 117.



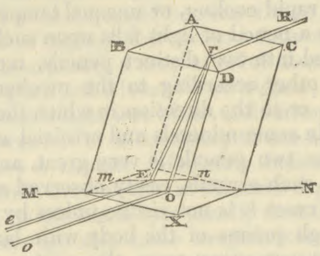
Inclination of the faces ABCB′, AB′C′B″....	105°	5′	
Inclination of the faces ABCB′, A′CBC″....	74	55	
Plane angle between the edges AB, AB′....	101	55	
——— AB, BC......	78	4	59″
Inclination of the faces to the axis AA′.......	45	23	26
Angle between the edges AB, AB′, &c. and the axis AA′..........	66	44	45
Inclination of the edges AB, AB′, to the opposite faces AB′CB″, &c..........	109	8	12
——— A′C, A′C, to the opposite faces ABCB′..........	70	51	48
Length of the diagonal AA′, the sides AB AC being unity......	1·2598		

Double Refraction.

As Iceland spar cleaves equally in planes parallel to all its six faces, it is easy to cut out of any mass of it an accurate rhombohedron in which all the three sides AB, A′ B , A″B″, are equal; but for the purposes of experiment it is sufficient to have a piece with two smooth and parallel faces formed by cleavage, or ground and polished parallel to the cleavage planes.

Let AX be such a piece of Iceland spar, and ABDC its upper surface. If we place its lower surface upon a piece of paper having a black line MN, drawn upon it, and if we place the eye above the upper surface, we shall see the line MN distinctly doubled; or if it should appear single, the two images will separate, by turning the spar a little round, and the line will appear double as at MN, and *mn*. The one line will be found to coincide with the other, when MN is parallel to AD, the short diagonal of the rhomboidal face ABDC, and the lines will appear most separated, when MN is parallel, as in the figure, to the long diagonal BC. If a black spot is used in place of a line placed at O, it will appear double in every position, and in turning the crystal round, the other image E will seem to revolve round O.

Fig. 118.

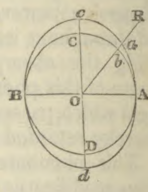


The best way, however, of shewing the double refraction of the Iceland spar, is to make a ray of light R*r*, fall upon the crystal at *r*. This ray will be refracted into two pencils or rays, *r*O, *r*E, and these will be again refracted at the second surface of the spar in directions E*e*, O*o*, parallel to the original ray R*r*. If we measure the angles of refraction of the fixed ray O*o*, corresponding to several angles of incidence from 0° to 90°, we shall find that these angles are always to one another in the constant ratio of 1 to 1·654, and that the refracted ray *r*O is always in the plane of incidence. It follows, therefore, that this ray is refracted as in water and glass, according to the ordinary law of refraction discovered by Snellius. Hence it is called the *ordinary ray*. But if we make the same experiments on the other ray *r*E, we shall find that at an incidence of 0°, in place of passing on unrefracted, it is actually refracted 6° 12′; that at other incidences its angles of refraction are not regulated by the law of Snellius, and that the ray *r*E is not in the plane of incidence. We conclude, therefore, that the ray *r*E is refracted according to some new or extraordinary law which remains to be investigated, and hence the ray *r*E is called the *extraordinary ray*.

If we grind down the two solid obtuse angles A, A′, fig. 116, so that the ground surfaces are perpendicular to the axis AA′, and if we polish their surfaces, and transmit a ray perpendicularly through them, so as to be parallel to the axis AA, we shall find that there is only one refracted ray, and hence there is no double refraction along the axis. Now this line AA′ is not a *fixed axis* like that of the earth ; it is merely a *fixed direction ;* for every line parallel to AA′ enjoys the property of an axis, as there is no double refraction in lines parallel to AA′.

In order to obtain an accurate idea of the law of extraordinary refraction, or that by which the extraordinary ray *r*E is regulated, let us take a rhomb, such as that shewn in fig. 117, and grind it into an accurate sphere, and then polish it. Let ACBD be such a sphere, AB being its axis of double refraction, corresponding with AA′ in fig. 117, and let O be its centre. If we now bend a piece of sheet lead or sheet copper into an arch ADB, and making a small hole in it opposite to A, and another opposite to B, cement a handle to it about D, it will enable us, in the following manner, to detect the general law of extraordinary refraction. The use of the two holes in this experiment is to ensure that the light admitted through one of them, and emerging at the other, shall pass through the centre O of the sphere. Let one of the holes be now placed in the surface of the sphere at A, and the eye at the other hole at B, the hole will appear single, shewing that the double refraction is there nothing. Let the hole be shifted gradually from A to C, and the other hole will move from B to D. In the different positions from A to C, it will be seen that the hole begins to become double on leaving A, and that the distance of the two images of it gradually increases from A to C, where it becomes a maximum. The same result will be obtained by making the hole move from A to D, or in any quadrant of the sphere passing through the poles A and B. The very same result will be obtained if the hole moves from B to C, or from B to D. If we now make one of the holes move along the equator COD, we shall find that by placing the eye at the other hole, the distance of the images will be exactly the same, or the double refraction the same in every part of the equator. Hence the general law of double refraction in crystals with one axis, is a very simple one : it is nothing at the poles; it increases gradually from the poles to the equator, where it is a maximum ; it is the same in the same parallels of latitude; and the preceding experiments will also shew that the line joining the centres of the two images is in the plane of the meridian.

Fig. 119.



Let the index of extraordinary refraction be now measured at the pole A, where it is the same as the ordinary index, and at the equator C, and it will be found to be 1·654, or m, in the former case, and 1·488, or m', in the latter. Now Huygens was led by a theory which has been explained under CHROMATICS, to the following law, which he verified by experiment, and which has been confirmed by the experiments of Wollaston, Malus, and other philosophers. Upon the axis AB of the sphere, fig. 118, describe an ellipse A*c*, B*d*, whose lesser axis AB is to its greater axis *cd* as $\frac{1}{m}$ is to $\frac{1}{m'}$, or as $\frac{1}{1·654}$ is to $\frac{1}{1·488}$, or as ·604 to ·674 ; and if an oblate spheroid is supposed to be generated by the revolution of this ellipse round its lesser axis AB, the reciprocal of the index of refraction of the extraordinary ray at any point of the spheroid will be measured by its radius at that point; that is, if R*ab*O is a ray incident at *b*, the radius $\frac{1}{Oa}$ will be the extraordinary index of refraction for that ray. If we therefore make

φ=ROA, or the inclination of the incident ray to the axis.
R=*cd*, the major axis of the spheroid.
r=AB, the lesser axis.

Then it may be shewn, as Malus has done,[1] that

$$Oa = \frac{Rr}{\sqrt{(r^2 \sin.^2\varphi + R^2 \cos.^2\varphi)}};$$

[1] *Theorie de la Double Refraction*, p. 143.

and as the index of refraction of the extraordinary ray is the reciprocal of this radius, we have

$$m' = \frac{\sqrt{(r^2 \sin.^2 \varphi + R^2 \cos.^2 \varphi)}}{Rr}, \text{ or}$$

$$m'^2 = \frac{1}{r^2} - \left(\frac{R^2 - r^2}{R^2 r^2}\right) \sin.^2 \varphi.$$

In the case of Iceland spar, we have

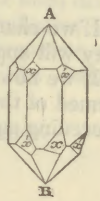
$$m'^2 = 2{\cdot}736693 - 0{\cdot}536510 \sin.^2 \varphi, \text{ or}$$

$$m' = \sqrt{2{\cdot}736693 - 0{\cdot}536510 \sin^2 \varphi}.$$

As the index of extraordinary refraction thus found, is always equal to the index of the ordinary refraction *minus*, another quality which depends on the difference between the radius of the sphere and that of the spheroid, the crystals in which this happens may be called *negative* doubly refracting crystals.

The preceding law of double refraction was believed by Malus to be universal, and applicable to all crystals that had this property. M. Biot, however, discovered that in quartz or rock crystal the extraordinary ray had its index of refraction m' greater than the ordinary index m. This mineral crystallises in six-sided prisms, as shewn in the annexed figure, terminated by six-sided pyramids, A and B. If we grind down and polish the summits A and B of a large crystal, perpendicular to the axis AB, and if we determine the index of refraction when the rays pass along AB, we shall find it to be as Malus found it, 1·5484, and without any double refraction, and 1·5544 in a direction perpendicular to the axis.

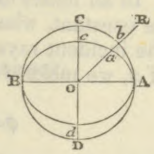
Fig. 120.



If we now grind the crystal into a sphere ACBD, fig. 121, and if we perform the very same experiments with it as we did with Iceland spar, we shall obtain analogous results. The double refraction will be found to increase from the poles A, B, to the equator CD, and to be the same in every part of the equator, and in each parallel of latitude; the only differences between it and calcareous spar being that the double refraction is less, and that the index of refraction of the extraordinary ray is always *greater* than that of the ordinary ray.

The extraordinary refraction of quartz will, therefore, as M. Biot has shewn, be represented by a prolate spheroid generated by the revolution of the ellipse A*c*B*d*, whose greater axis AB is to the lesser *cd* as $\frac{1}{1{\cdot}5484}$ is to $\frac{1}{1{\cdot}5544}$, or as ·6458 is to ·6418. Hence, if R*ba*O is a ray incident on the sphere at *b*, the radius $\frac{1}{Oa}$ will be the index of extraordinary refraction for that ray. Hence we shall obtain

Fig. 121.



$$Oa = \frac{Rr}{\sqrt{(r^2 \sin.^2 \varphi - R^2 \cos.^2 \varphi)}}, \text{ and}$$

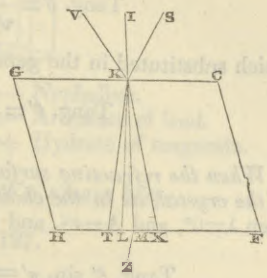
$$m^2 = \frac{1}{r^2} + \frac{R^2 - r^2}{R^2 r^2}, \sin.^2 \varphi.$$

Hence, as the index of extraordinary refraction is equal to the index of ordinary refraction, *plus*, another quantity depending on the difference between the radius of the sphere and that of the prolate spheroid, crystals which have this property may be called *positive* doubly refracting crystals.

The following geometrical rule of finding the direction of the extraordinary ray, when the incident ray forms different angles with the axis given by Huygens,[1] may be interesting to some of our readers. Let CGHF be what is called the *principal section* of a crystal of calcareous spar, &c., or a plane passing through the axis, which will be in the direction CH. Let SK, VK, be rays incident on that plane upon the surface CG, and equally inclined to IKL, perpendicular to the surface at the point of incidence K; then if KM is the refracted ray, corresponding to a ray IK, incident perpendicularly, the other rays VK, SK, will be refracted in directions KT, KX, so that TM is equal to XM.

Double Refraction.

Fig. 122.



Although the determination of the extraordinarily refracted ray is very simple, when the crystal is supposed to be spherical, yet the formula becomes complicated when we suppose the ray incident in any given direction upon a natural surface of Iceland spar. Malus has investigated such a formula, but our limits will not allow us to give more than the resulting expression.

Making θ = the angle of incidence,

θ' = the angle of extraordinary refraction,

π = the azimuth of incidence, or the angle which the plane of incidence forms with the axis.

π' = the same angle for the extraordinary ray.

λ = the inclination of a line perpendicular to the face of incidence to the axis of the crystal.

$A = R^2 \sin.^2 \lambda + r^2 \cos.^2$,

$C = \sin. \lambda \cos. \lambda\, (R^2 - r^2)$. Then

$$\text{Tang. } \theta' \cos. \pi' = \frac{R^2 r^2 \sin. \theta \cos. \pi}{A\sqrt{A - R^2 \sin.^2 \theta\, (r^2 \cos.^2 \pi + A \sin.^2 \pi}} + \frac{C}{A},$$

and

$$\text{tang. } \theta' \sin. \pi' = \frac{R^2 \sin. \theta \sin. \pi}{\sqrt{A - R^2 \sin.^2 \theta\, (r^2 \cos.^2 \pi + A \sin.^2 \pi.)}}$$

When the refracting surface is parallel to the axis, (as in the six-sided prism of calcareous spar), we shall have $\lambda = 90$, in which case $A = r^2$ and $C = 0$. The formula then becomes

$$\text{Tang. } \theta' \cos. \pi = \frac{r^2 \sin. \theta \cos. \pi}{R\sqrt{1 - \sin.^2 \theta\, (r^2 \cos. \pi + R^2 \sin.^2 \pi)}}.$$

$$\text{Tang. } \theta' \sin. \pi = \frac{R \sin. \theta \sin. \pi}{\sqrt{1 - \sin.^2 \theta\, (r^2 \cos.^2 \pi + R^2 \sin.^2 \pi)}}.$$

and dividing the one equation by the other, we have

$$\text{Tang. } \pi' = \frac{R^2}{r^2} \text{tang. } \pi.$$

When the refracting surface is parallel to the axis, and the plane of incidence perpendicular to the axis, then $\pi = \pi' = 90°$, or $\lambda = 90$; consequently $\cos. \pi' = 0$, and the first equation becomes

$$\text{. Tang. } \theta' = \frac{R \sin. \theta}{\sqrt{1 - R^2 \sin.^2 \theta'}} \text{ and } \sin. \theta' = R \sin. \theta.$$

When the refracting surface is parallel to the axis, and the plane of incidence passes through the axis, in which case the refraction is in the plane of a *principal section*, then $\pi = \pi' = 0°$, the second equation becomes

[1] *Traité de la Lumière*, sect. 17.

Double Refraction.

$$\text{Tang. } \theta' = \frac{r}{\text{R}} + \frac{r \text{ sin. } \theta}{\sqrt{1 - r^2 \text{ sin.}^2 \theta}},$$

or, by substituting r sin. θ for its equal sin. θ, we have

$$\text{Tang. } \theta' = \frac{r \text{ sin. } \theta}{\sqrt{1 - r^2 \text{ sin.}^2 \theta}},$$

which substituted in the general formula, gives

$$\text{Tang. } \theta' = \frac{2}{\text{R}} \text{Tang. } \theta.$$

When the refracting surface is perpendicular to the axis of the crystal, as in the chaux carbonatée baseé of Hauy, then $\lambda = 0°$, and $\text{A} = r^2$, and $\text{C} = 0$. Hence

$$\text{Tang. } \theta' \text{ sin. } \pi' = \frac{\text{R}^2 \text{ sin. } \theta \text{ sin. } \pi}{r \sqrt{1 - \text{R}^2 \text{ sin.}^2 \theta'}},$$

$$\text{Tang. } \theta \text{ Cos. } \pi' = \frac{\text{R}^2 \text{ sin. } \theta \text{ cos. } \pi}{r \sqrt{1 - \text{R}_2 \text{ sin.}^2 \theta}}.$$

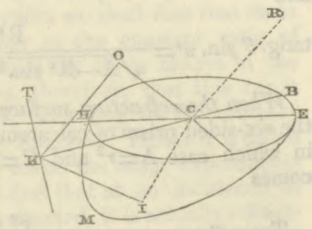
and dividing the one equation by the other we have

Tang. π' = Tang. π, and $\pi' = \pi$, which shews that the refracted ray is in the plane of the incident ray. Hence we obtain from the preceding equation,

$$\text{Tang. } \theta' = \frac{\text{R}^2 \text{ sin. } \theta}{r \sqrt{1 - r^2 \text{ sin.}^2 \theta}}$$

In order to find the path of the extraordinarily refracted ray, Huygens has given the following elegant geometrical construction. Let EBH be the elliptical section of the oblate spheroid which regulates the double refraction of the crystal, formed by the surface upon which the ray is incident. Let the ray RC fall upon its centre, and let BCK be the intersection of the plane of incidence with the face of the crystal. Let EMH be a part of the oblate spheroid within the crystal or below its surface, the axis of the spheroid passing through and having any inclination to the surface. Then draw in the plane KCR a line CO perpendicular to RC, and having drawn OK perpendicular to OC, or parallel to CR, make OK equal to $\frac{1}{3m \text{ incid.}}$ or the reciprocal of the sine of the angle of incidence. Through K draw KT perpendicular to the plane of incidence BRCK, and through KT draw a plane which shall touch the spheroid. Let I be the point where this plane touches the spheroid, then drawing the line CI, this line will be the extraordinarily refracted ray.

Fig. 123.



Doubly refracting lenses.

As there are several researches and instruments in which it may be required to find the focus of the extraordinary pencil when the doubly refracting substance has the form of a lens, we shall here give the formula obtained by Malus. Calling r, r' = the radii of the anterior and posterior surfaces of a convex lens,

d = the distance of the radiant point,

a = the larger semi-axis of the spheroid of double refraction.

b = the shorter semi-axis of do.

F = the focal length for the ordinary ray.

f = the focal length of the extraordinary ray, when d is infinite, or the rays parallel, and

φ = the focal length of the extraordinary ray required.

Thus Malus has shewn that

$$\varphi = -\frac{a^2 bdrr'}{d(r+r')(2b^2 - a^2 - a^2 b) - a^2 brr'};$$

$$\text{F} = \frac{-brr'}{(r+r')(1-b)}.$$

When the radii r, r', are equal, or the lens *equally convex*, we have

$$\varphi = -\frac{a^2 bdr}{2d(2b^2 - a^2 - a^2 b) - a^2 br},$$

$$f = -\frac{a^2 br}{2(2b^2 - a^2 - a^2 b)}.$$

If we suppose a to be equal to b, or the spheroid to become a sphere, by which the ordinary refraction is regulated, we obtain for the ordinary ray,

$$\text{F} = \frac{br}{2(1-b)}.$$

Hence, the difference between the ordinary and extraordinary focal lengths will be

$$f - \text{F} = 2\text{ F} \frac{a^2 - b^2}{2b^2 - a^2 - a^2 b}.$$

If we change the signs of r and r' in these expressions, they will apply to *concave* lenses.

Lens of Iceland spar.

If we now take *Iceland spar*, and suppose the lens to be formed of that substance, we have only to substitute in the preceding equation, the following values of a and b,[1] viz.:—

$a = 0{\cdot}6741717$
$b = 0{\cdot}6044871$, whence
$m = 1{\cdot}65429$
$m' = 1{\cdot}48330$,

we obtain

$\varphi = -r.\ 8{\cdot}8228602$
$\text{F} = -r.\ 0{\cdot}764180$
$f - \text{F} = -\text{F}.\ 114{\cdot}4546$

In the case of *quartz* or *rock crystal*, where

$a = 0{\cdot}645813$
$b = 0{\cdot}641776$
$m = 1{\cdot}558176$
$m' = 1{\cdot}548435$,

we obtain

$\varphi = -r.\ 0{\cdot}962824$
$\text{F} = -r.\ 0{\cdot}895775$
$f - \text{F} = -\text{F}.\ 0{\cdot}074846.$

In all lenses of the same substance, the ratio of f to F will be constant, whatever be the form of the lenses, provided the incident rays are parallel. If, in the general expression of φ, we make d infinite, we have

$$\varphi = \frac{a^2 brr'}{(r+r')(2b^2 - a^2 - a^2 b)}.$$

and making $a = 0$, we have for the ordinary ray,

$$\text{F} = -\frac{brr'}{(r+r')(1-b)},$$

whence

$$\frac{\varphi}{\text{F}} = \frac{a^2(1-b)}{2b^2 - a^2 - a^2 b}.$$

a result independent of the values of r and r'.[2]

The focus of the rays refracted extraordinarily by a doubly refracting lens, becomes more and more distant, as

[1] Malus, *Theorie*, &c., p. 278, sect. 66.

[2] Id. Id. p. 281, sect. 66.

Double Refraction.

the axis of double refraction of the crystal approaches to the axis of the lens; and the preceding formulæ apply solely to the case where these two axes are parallel, as it is only in that case that such lenses can be of any use.

List of the Primitive Forms and Crystals which have one axis of Double Refraction.

From a very extensive series of experiments on the double refraction of crystallised bodies, Sir David Brewster was led to the general law, that all crystals whose primitive form has only *one axis* of figure, or one pre-eminent line, round which the matter of the crystals is symmetrically arranged, had also *one axis* of double refraction, and that their axis of figure was likewise the axis of double refraction.

The following are the primitive forms which possess this geometrical and optical property:—

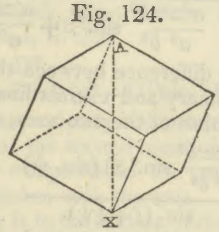
The rhombohedron with an obtuse summit.
The rhombohedron with an acute summit.
The regular six-sided prism.
The octohedron with a square base.
The right prism with a square base.

Table of Crystallised Minerals and other bodies which have one axis of double refraction.

In the following table the crystals are arranged under their primitive forms, so far as these forms have been determined by crystallographers. The sign + indicates that the crystals have *positive* double refraction, like *quartz*, and — that they have *negative* double refraction, like *Iceland spar.*

1. *Rhombohedron with an obtuse summit.*

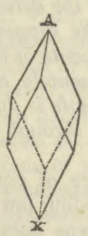
Fig. 124.



— Carbonate of lime (Iceland spar).
— Carbonate of lime and iron.
— Carbonate of lime and magnesia.
— Phosphato-arseniate of lead.
— Carbonate of zinc.
— Nitrate of soda.
— Phosphate of lead.
— Ruby silver.
— Levyne.
— Tourmaline.
— Rubellite.
— Alum stone.
— Gmelinite.
— Chlorate of soda.
+ Dioptase.
+ Quartz.

2. *Rhombohedron with acute summit.*

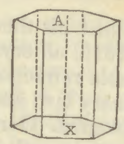
Fig. 125.



— Corundum.
— Sapphire.
— Ruby.
— Cinabar.
— Arseniate of copper.

3. *Regular six-sided prism.*

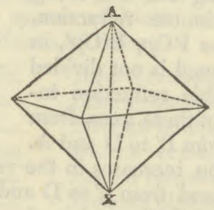
Fig. 126.



— Emerald.
— Beryl.
— Apatite.
— Nepheline.
— Arseniate of lead.
+ Hydrate of magnesia.

4. *Octohedron with a square base.*

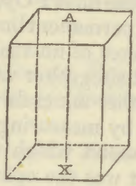
Fig. 127.



+ Zircon.
+ Oxide of tin.
+ Tungstate of lime.
— Mellite.
— Molybdate of lead.
— Octohedrite.
— Muriate of potash.
— Cyanide of mercury.

5. *Right prism with a square base.*

Fig. 128.



— Idiocrase.
— Wernerite.
— Paranthine or scapolite.
— Meoinite.
— Somervillite.
— Edingtonite.
— Arseniate of potash.
— Subphosphate of potash.
— Phosphate of ammonia and magnesia.
— Sulphate of nickel and copper.
— Hydrate of strontites.
+ Apophyllite of Uton.
+ Oxahverite.
+ Superacetate of copper and lime.
+ Titanite.
+ Ice, certain crystals.
Murio-carbonate of lead.

The following crystals and organised bodies have one axis of double refraction, but their primitive form has not been accurately determined.

	Position of the axis.
— Muriate of lime..	Axis of six-sided prism.
— Muriate of strontian........	Do. do.
— Hyposulphate of lime[1]	Axis of hexagonal tables.
— Mica from	Perpendicular to laminæ.
— Mica, with amianthus.......	Perpendicular to the laminæ.
— Nacre, (See *Phil. Trans.* 1836, p.)...........	Perpendicular to laminæ.
+ Boracite..........................	Axis of rhomb of 90°.
+ Apophyllite, (*surcomposee* of Hauy),...	Perpendicular to the table.
+ Sulphate of potash and iron,......................	Axis of six-sided prism.
Tortoise shell, (Sir. J. Herschel),..............	

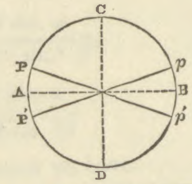
[1] Sir John Herschel.

Sect. II.—*On the Law of Double Refraction in Crystals with two axes.*

When M. Malus published his theory of double refraction, and even so late as 1816, all crystals were believed to have only one *axis* of double refraction, one of the rays being refracted by the ordinary law, and the other by the extraordinary law, above explained. During the examination of an extensive class of minerals and artificial salts, Sir David Brewster was led to the discovery of crystals with *two axes of double refraction.*

The general character of the phenomena presented by such crystals will be understood from fig. 129, where we may suppose, as before, the crystal to have the form of a sphere. In place of there being one line along which there is no double refraction, there are two such as P*O*p, P′*O*p′, in which the incident pencil is not divided into two. The double refraction increases on each side of these axes, from P, to C and A, and from P′ to D and A. The double refraction increases in the very same manner from *p* to C and B, and from *p*′ to D and B, according to a law which will afterwards be explained.

Fig. 129.



In continuing his investigations, Sir David Brewster found crystals in which the axes P*O*p, P′*O*p′ formed all possible angles with each other from 0° up to 90°, and he was led also to the important result, that these two axes were not real axes of double refraction like those in uniaxal crystals, but were only *resultant axes*, as he called them, or *axes of compensation.* The grounds on which he formed this opinion were, that these lines P*O*p, P′*O*p′ had no relation whatever to any fixed or permanent lines in the primitive form of the crystals, like the axes of uniaxal crystals, and that the double refraction did not altogether vanish along these lines, as in Iceland spar and other minerals with no axis. He was led to these results, not by measuring the double refraction itself, but by the phenomena which will be presently explained. At this time it was the opinion of our author, and afterwards that of M. Biot and other distinguished philosophers, that in *biaxal* as in uniaxal crystals, one of the rays was refracted according to the ordinary law of Snellius, and the other according to an extraordinary law, and hence the investigation of the extraordinary law occupied the attention of our author.

In commencing this inquiry, he assumed as the two real axes of double refraction, the line AB bisecting the angle formed by the apparent or resultant axes P*O*p, P′*O*p′, and another line at right angles to it, viz. either the line CD, or the line perpendicular to it passing through O.

If the principal axis AB is *positive*, then if we assume O as the second axis, it must be taken *positive* also; but if CD is assumed as the second axis, it must be taken *negative.* Now, it is obvious that if we take AB as a *positive*, and CD as a *negative* axis, the double refraction in the direction AB is the maximum double refraction of the axis CD, because the effect of the axis AB is here nothing. In like manner, the double refraction along CD is a measure of the maximum double refraction of the axis AB. Hence we can easily ascertain the relative intensities of the doubly refracting force of each axis AB and CD. Having done this, the next step was to compute the double refraction at the point P produced by the positive axis AB acting alone as a single axis, and also the double refraction produced at the same point P, by the negative axis CD. When this was done, the two double refractions were found to be equal and opposite, and hence they compensated each other, and produced an axis P*p*, in which there was no double refraction, and which was the resultant of the actions of AB and CD.

In this way, and by experiments which will be related in a subsequent chapter, our author was led to the following method of finding the general law of extraordinary refraction in biaxal crystals.

Make b = axis of revolution of the two spheroids.
a, a' = the other axis of the spheroid.
β, β' = the inclination of the incident ray to the axes of the crystal.
ψ = the angle of the doubly refracting forces emanating from each axis.
ζ = half the difference of the angle at the base of the parallelogram of forces.

Then, as the velocity of the ray is inversely as the variable radius of the spheroid, $\frac{1}{b^2}$ will be the square of the velocity of the ordinary ray, and $\frac{1}{a^2}, \frac{1}{a'^2}$ the square of the minimum velocity of the extraordinary ray, in virtue of the separate action of each axis, AB and CD. Hence the difference between the squares of the velocities of the ordinary and extraordinary rays will be

$$\left(\frac{a^2 \pm b^2}{a^2 b^2}\right) \sin.^2 \beta$$

$$\left(\frac{a'^2 \pm b^2}{a'^2 b^2}\right) \sin.^2 \beta$$

the sign being positive when the axis is positive, and *vice versa.* But as these expressions represent the sides of the parallelogram of forces, we have

$$\text{Tang. } \zeta = \frac{\left(\frac{a^2 \pm b^2}{a^2 b^2} \sin.^2 \beta\right) - \left(\frac{a'^2 \pm b^2}{a'^2 b^2} \sin.^2 \beta'\right) \text{tang. } \tfrac{1}{2}\psi}{\frac{a^2 \pm b^2}{a^2\, b^2} \sin.^2 \beta + \frac{a' \pm b^2}{a'^2 b^2} \sin.^2 \beta'.}$$

Consequently the difference between the squares of the velocities of the ordinary and extraordinary ray produced by the combined action of the two axes, will be

$$\frac{\left(\frac{a^2 \pm b^2}{a^2\, b^2} \sin.^2 \beta\right) (\sin.\ \psi)}{\sin.\ (\zeta + \frac{1}{2}\psi).}$$

Hence, calling V the velocity required, we have

$$V^2 = \frac{1}{b^2} + \frac{\left(\frac{a^2 \pm b^2}{a^2\, b^2} \sin.^2 \beta\ (\sin.\ \psi)\right.}{\sin.\ (\zeta + \frac{1}{2}\psi)}, \text{ and}$$

$$V = \left|\frac{1}{b^2} + \frac{\frac{a^2 \pm b^2}{a^2\, b^2} \sin.^2 \beta)\ (\sin.\ \psi)}{\sin.\ (\zeta + \frac{1}{2}\psi)}\right|^{\frac{1}{2}}$$

The form of the compound, or irregular spheroid, may therefore be computed for all doubly refracting crystals.

The general law of extraordinary refraction which has now been explained, may be thus expressed.

The increment of the square of the velocity of the extraordinary ray produced by the action of two axes of double refraction, is equal to the diagonal of a parallelogram whose sides are the increments of the square of the velocity produced by each axis separately, and calculated by the law of Huygens, and whose angle is double of the angle formed by the two planes passing through the ray and the respective axes.

When the two axes are of equal intensity, and of the same character, the preceding law gives the very same results as the law of Huygens does for one axis placed at right angles to the other two.

From these views it follows as a necessary consequence, a consequence first deduced from them by M. Biot, that the difference of the squares of the velocities of the two rays are proportional to the product of the sines of the angles which each of them make with the two resultant axes P and P′, and hence making these angles φ and φ', and V the velocity of the extraordinary, and v that of the ordinary ray, we shall have $V = (v^2 + a \sin.\varphi \times \sin.\varphi')^{\frac{1}{2}}$, a being a constant coefficient.

Fres- law.

M. Fresnel was led by theoretical considerations to suppose that in crystals with two axes, the law of double refraction was still more complicated; and he soon confirmed the accuracy of his views by direct experiment, and was thus able to establish a general law which embraced all crystals with one axis.

Our limits will not allow us to do more than give the following brief abstract of his labours, which we owe to M. Pouillet.[1]

When the light is incident in the plane perpendicular to AB, fig. 129. that is in the plane of CD, *one* of the *two* rays is regulated by the ordinary law of refraction, whereas when the ray is incident in the plane AB, perpendicular to the axis CD, the *other* of the two rays is regulated by the ordinary law of refraction. The formulæ by which Fresnel expressed his law, are as follow:

making V=the velocity of the ordinary ray.

v=that of the extraordinary ray.

A=the angle of the ray with the one axis.

a=the angle of the ray with the other axis.

D=*ordinary* velocity in *uniaxal* crystals, or the *constant* velocity in the section perpendicular to CD, fig. 129, in *biaxal* crystals.

d'=the *extraordinary* velocity in *uniaxal* crystals, or the *constant* velocity in the section perpendicular to AB, fig. 129, then

$$V^2 = D^2 + (d^2 - D^2)\sin^2\tfrac{1}{2}(a - A)$$
$$v^2 = D^2 + (d^2 - D^2)\sin^2\tfrac{1}{2}(a + A)$$

In *uniaxal crystals*, when the *two* axes are reduced to *one*, we have A=a, so that

$$V^2 = D^2$$
$$v^2 = D^2 + (d^2 - D^2)\sin^2 A,$$

that is, the ordinary velocity is constant in all directions and equal to D, and, as the second equation indicates, the extraordinary velocity v depends on the angle A, which the extraordinary ray makes with the axis.

When this ray is in the section perpendicular to the axis, we have A=90°, and $\sin.^2 A = 1$, hence $V' = d$.

When the ray is parallel to the axis A=0°, and $\sin.^2 A = 0$, whence v=D, so that in this direction only the extraordinary becomes equal to the ordinary velocity.

In *biaxal crystals*, when the ray is in the section perpendicular to CD, fig. 129, it is evident that it always forms equal angles with the axes Pp, P′p'. Hence A=a, and $\sin.^2\frac{1}{2}(a - A) = 0$, consequently $V^2 = D^2$, or V=D. In this way D is the expression of the velocity in this case, and it is on this account that the term *ordinary velocity* is applied to all those which are given by the different values of V.

When the ray on the contrary, is in the section perpendicular to AB, the sum of the angles A and a is always equal to two right angles, and $\sin.\frac{1}{2}(A + a) = 1$, whence it follows that $V^2 = d^2$, and V=d, and it is on this account that the term *extraordinary velocity* is applied to all those that are given by the values of v.

When d is greater than D, the *minimum* of the ordinary velocity takes place when a=A, or when V=D, and the *maximum* takes place when a—A is the greatest possible, which happens in the plane of the axes APCBDP′. The *minimum* becomes the *maximum*, and *vice versa* when D is greater than d. The *maximum* and *minimum* for the extraordinary ray take place also, when $v=d$, and consequently for the case when the ray is in the plane of the axes, but they in like manner change their part when d is greater or less than D.

In every case the difference of the squares of the velocities is expressed by the formula

$$v^2 - V^2 = (d^2 - D^2)\sin.a.\sin.A.$$

That is to say, the two ordinary and extraordinary rays having a common direction, the difference of the squares of their velocities are proportional to the product of the sines of the angles which each of them makes with the two axes. "This remark, adds M. Pouillet, had been made by Sir David Brewster and M. Biot before Fresnel had pointed out the simple law which embraces the phenomena in all its extent."

List of the primitive forms of Crystals that have two axes of double refraction.

Crystals with two axes.

From a great number of experiments, Sir David Brewster found that the property of possessing *two* axes of double refraction belonged to all the crystals that are included in the *prismatic system* of Mohs, or which have the following primitive forms of Hauy:—

A right prism,	Base a rectangle.
———	Base a rhomb.
———	Base an oblique parallelogram.
Oblique prism	Base a rectangle.
———	Base a rhomb.
———	Base an oblique parallelogram.
Octohedron	Base a rectangle.
———	Base a rhomb.

In these solids there is no single line or axis of symmetry.

The following table, which we could have enlarged considerably, contains most of the crystals with two axes, whose primitive forms have been determined by crystallographers:—

1. *List of Crystals of known Primitive Forms, and having Two Axes of Double Refraction.*

1. *Right Quadrangular Prism—Base a Rectangle.*

	Position of Principal Axis.	*Position of Second Axis.*
Cymophane, *Young.*	Axis of right prism.	Perp. to the sides.
Peridot, ditto.	Perp. to axis.	Axis of right prism.
Prehnite, ditto.		
Stilbite, ditto.	Parallel to longest side of prism, or perp. to best cleavage planes.	Axis of right prism, or perp. to longest faces.
Comptonite, *Brooke.*	Perp. to axis of right prism.	Axis of that prism, or other axis.
Thomsonite, ditto.	Perp. to axis of prism.	Axis of the prism.
Anhydrite, *Bournon.*	Axis of right prism.	Perp. to sides of prism
Tartrate of potash, ditto.	Perp. to the flat rhomb. faces.	Parallel to a side of rhomb. prism.
Staurotide, *Hauy.*		
Datholite, do.		
Mica, do.	Axis of right prism.	Greater diagonal of its rhomb. base.
Talc, do.	Axis of right prism.	Diagonal of its rhomb base.
Spodumene, do.	Axis of prism.	In plane of laminæ.
Sulphate of barytes, ditto.	Short diagonal of rhomb. base.	Long diagonal, or axis of prism.
Sulphate of strontian, do.	Axis of the prism.	Perp. to axis of prism.
Sulphate of soda, *Bournon.*		
Citric acid, do.		
Tartrate of potash and soda, do.		
Chromate of lead, do.		
Stilbite, *Brooke.*	Perp. to laminæ.	In plane of laminæ.
Mesotype of Auvergne, do.	Axis of prism.	Perpendicular to axis.

[1] *Elémens de Physique Expérim.* liv. viii. cap. 1.

Double Refraction

3. *Right Quadrangular Prism—Base an Oblique Parallelogram.*

Names of Minerals.	*Position of Principal Axis.*	*Position of Second Axis.*
Needlestone of Faroe, do.	Axis of prism.	Perpendicular to axis.
Sulphate of lime, *Hauy.*	In plane of the laminæ.	Axis of prism.
Epidote, do.	In base of prism.	Axis of prism.
Axinite, do.		
Heulandite, *Brooke.*		
Brewsterite, do.		
Sulphato-carb. of lead, do.	Perp. to laminæ.	In plane of laminæ.
Acetate of strontian.		

4. *Oblique Quadrangular Prism—Base a Rectangle.*

Borax, *Hauy.*
Euclase, do.

5. *Oblique Quadrangular Prism—Base a Rhomb.*

Diopside, *Hauy.*	Perpendicular to sides of the prism.	Axis of prism, or other axis.
Euclase, do.		
Augite, do.		
Glauberite.		
Grammatite.		
Sulphate of iron, *Wollaston.*		
Super-sulphate of potash, *Bournon.*	Perp. to axis of prism.	Axis of prism.
Acetate of copper, do.	Perp. to axis of prism.	Axis of prism.
Tartaric acid, do.	Axis of prism.	Perpendic. to faces.
Oxalic acid, do.		
Sugar, do.		
Hydrate of strontian.		
Bitartrate of potash.		
Sulphate of soda.		

6. *Oblique Quadrangular Prism—Base an oblique Parallelogram.*

Feldspar, *Hauy.*
Kyanite, do.
Sulphate of copper, do.

7. *Octohedron with a Rectangular Base.*

Nitrate of potash.	Axis of octohedron.	Perp. to sides of base
Arragonite.	Axis of prism or perpendicular to axis of octohedron.	Perp. to sides of base
Carbonate of lead.	In plane of base of two pyramids.	Axis of the octohedron.
Sulphate of lead.	Axis octohedron.	Perp. to sides of rect. base.
Topaz.		
Muriate of copper.	Long diagonal of rhomb. base.	Short diagonal of the rhomb. base.

8. *Octohedron with a Rhombic Base.*

Sulphur, *Hauy.*		
Sphene, do.		
Carbonate of soda, do.	Diagonal of base through *o* of Hauy, Pl. xxxix.	Axis of octohedron or other axis.

9. *Minerals belonging to the Prismatic System of Mohs, and having* TWO *axes, but not included in any of the above divisions of Hauy.*

Names of Minerals.	*Position of Principal Axis.*	*Position of Second Axis.*
Sulphate of magnesia, *Mohs.*	Cleavable diagonal of square base.	Perpendicular to axis, or the other diagonal.
Sulphate of manganese.		
Sulphate of zinc.	Axis of rhomboidal prism.	Short diagonal of rhomboidal base.
Sulphate of ammonia.	Axis of hexahed. prism.	Perp to axis.
Sulphate of cobalt.		
Carbonate of strontian, do.	Axis of prism.	Perp. to axis.
Carbonate of barytes, do.	Axis of prism.	Perp. to axis.
Diallage.	Perp. to plates.	Plane of plates.
Molybdate of ammonia.		
Muriate of barytes.		
Realgar.		
Orpiment.	In plane of laminæ.	Perp. to laminæ.
Lepidolite.	Perp. to laminæ.	Plane of laminæ.
Mesotype.	Axis of prism.	Perp. to axis.
Mesolite.	Ditto.	Ditto.
Serpentine.		
Natrolite.		
Sulphato-bi-carbonate of lead.	Axes of acute rhomb.	In plane of laminæ.
Phosphate of iron.	In plane of laminæ.	Perp. to laminæ.
Harmotome, Petalite, Chabasie.		

10. *Crystals, whose primitive form has not been determined, but which have been found to have two axes, and which must belong to the Prismatic System of Mohs.*

Iolite.	Axis of prism.	Perp. to axis of prism.
Indurated talc.	Perp. to plates.	In plane of laminæ.
Carbonate of potash.	Plane of axis perpendicular to the flat tables.	In plane of tables.
Carbonate of copper.		
Sulphate of ammonia and magnesia.	Shorter diagonal of the rhomboidal base.	Axis of hexagonal prism, or long diag. of rhomb. base.
Sulphate of soda and magnesia.		
Sulphate of nickel.	Short diagonal of the rhomboidal base.	Axis of prism, or other axis.
Oxy-nitrate of silver.	Perp. to rhomb plates	Long diagonal of rhomboidal plates.
Nitrate of ammonia.		
.... of lime.		
.... of strontian, with water of crystallization.		
.... of copper.		
.... of zinc.		
.... of mercury.		
.... of bismuth.		
Nitrate of lead, certain specimens.	Mr. Herschel, *Edin. Ph. Jour.* vol. ii. p. 184.	
Muriate of mercury.		
.... of magnesia.		
Acetate of lead.	Perp. to broad sides of prism.	Axis of prism, or other axis.
.... of zinc.	In plane of hexag. plates.	Perpendicular to hexag. plates.
.... soda.		
.... barytes.		
Phosphate of soda.		
Oxalate of ammonia.	Perp. to axis of prism.	Axis of prism.
Hyper-oxymuriate of potash.	Perpendic. to rhomb. plates.	Plane of axis in that diag.
Super-oxalate of potash.		
Super-chromate of potash.		
Crystallized Cheltenham salts.	Axis of prism.	Perp. to axis.
Murio-sulphate of magnesia and iron.	Cleavable diagonal of its square base.	Axis of prism, or other diag.
Benzoate of ammonia.	Perp. to laminæ.	In plane of do.
Benzoic acid.	Perp. to plates.	In plane of plates.
Chromic acid.		
Spermaceti.	Perp. to plates.	In plane of plates.
Boracic acid.	Perp. to hexag. plates.	In plane of plates.
Succinic acid.	Perp. to faces of flat prism.	In plane of these faces.
Super-tartrate of potash.	Perpendicular to axis of prism.	Axis of prism.
Tartrate of potash and antimony.	Perpendicular to axis of prism.	Axis of prism.
Camphor.		
Hydrate of barytes.	Perp. to flat plates.	In ane of plates.
Prussiate of potash.	Perp. to rect. laminæ.	In plane of laminæ.
Mother-of-pearl.	Perp. to laminæ.	In plane of laminæ.
Carbonate of ammonia.	Short diag. of rhomb, and perp. to best cleavage.	Axis of prism, or long diag.
Hyposulphite of lime.	Sir John Herschel, *Edin. Phil. Jour.* vol. i. p. 15.	
.... of barytes.	Sir John Herschel.	

Polarisation.

Crystals with three axes.

Sect. III.—*On Crystals with three Axes of Double Refraction.*

Having determined the primitive form to which those crystals belong which have *one* and *two* axes of double refraction, Sir David Brewster found that all those crystals which have no resultant axes, or, properly speaking, no double refraction, belonged to that class of primitive forms which have three rectangular axes of form, namely, the *cube*, the *regular octahedron*, and the *rhomboidal dodecahedron*, or to the *tessular* system of Mohs. Since, however, every real axis of double refraction, coincides with a prominent line in the primitive form of the crystal, he conceived that those crystals which had no apparent double refraction had actually *three equal rectangular axes*, the effect of which was to compensate each other at every point of the crystal, or, in other words, to have an infinite number of resultant axes.

In confirmation of these views, our author found various indications of positive and negative doubly refracting structures in *alum, diamond*, &c., as if these equal axes had not exactly compensated each other, either from the three not being perfectly equal, or from their not being placed accurately at right angles to each other.

The following is a list, which might be considerably extended, of the primitive forms of the crystals that have no double refraction.

Primitive form a cube.—Muriate of soda, muriate of potash, muriate of silver.

Primitive form an octahedron.—Diamond, fluor spar, muriate of ammonia, pleonaste, nitrate of lead, sulphate of alumina, soda, alum, ruby copper, spinelle, nitrate of strontian octahedral, nitrate of lead, nitrate of barytes, sulphate of ammonia and chromium, sulphate of ammonia and iron, sulphate of alumina and ammonia.

Primitive form a rhomboidal dodecahedron.—Garnet, blende, sodalite, essonite, helvin, lazulite.

There are some crystals, such as *arseniate of iron, amphigene, analcime, boracite, aplome*, all of which have double refraction, and therefore cannot belong to the tessular system.

Sect. IV.—*On Crystals with Planes of Double Refraction.*

In all the crystals to which we have hitherto referred, the double refraction is related to one or more axes; but Sir David Brewster has found, that in *analcime*, a mineral ranked in the tessular system, there are several planes or sections of the crystal in which there is no double refraction, the double refraction increasing with the distance from these planes, according to a law which will be afterwards mentioned. When the ray is incident in any direction that does not lie in one of these planes, it is separated into two images by double refraction. This is the only substance which is known to possess this remarkable property.

PART VII. ON THE POLARISATION OF LIGHT.

Polarisation of light.

The light emitted from the sun, from a candle, or from any self-luminous body, before it has suffered reflection from, or refraction by, any body, is called *common light*. If we allow a beam of such light to fall upon any refracting or reflecting body, whether transparent or metallic, or to pass by any diffracting body, it will suffer precisely the same changes, whether its upper, its under, its right or its left side, or any other side of the beam, is turned towards the refracting, reflecting, or diffracting body. Hence it follows, that this beam of light has the same properties in all its sides.

Now this is not true of all light. If the preceding beam of common light is reflected at a particular angle, from transparent bodies, or passes obliquely through a number of refracting surfaces, or is transmitted through certain crystals, or suffers total reflexion from the second surfaces of transparent bodies, or from the surface of metals;—in all these cases it has suffered such a change, that it no longer has the same properties in all its sides, but, on the contrary, exhibits distinct and remarkable properties in its different sides, or, what is the same thing, has *polarity*. This beam of common light is therefore said to be *polarised*. The different kinds of polarisation which may thus be impressed upon common light are three, viz. *plane polarisation, circular polarisation*, and *elliptical polarisation*; or the whole of these three kinds of polarisation may be included in the general name of *elliptical polarisation*, which becomes *circular* when the two axes of the ellipsis are equal, and *rectilineal* or *plane* when the minor axis of the ellipse is infinitely small. We shall now proceed to explain the phenomena of these three kinds of polarisation, in their order.

CHAP. I.—ON PLANE POLARISATION.

Plane polarisation.

There are four ways by which common light may be *plane polarised*.

1. By double refraction.
2. By one reflection from transparent bodies.
3. By several refractions through transparent surfaces.
4. By the absorption or dispersion of part of the light.

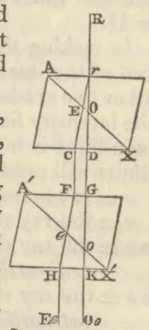
These various processes exhibit many interesting phenomena and laws, which we shall proceed to explain.

Sect. I.—*On the Polarisation of Light by Double Refraction.*

Polarisation by double refraction.

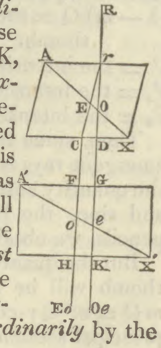
The polarisation of light by the double refraction of Iceland spar was discovered by Huygens. Upon examining the two pencils O *o*, E *e*, fig. 118, formed by double refraction, he found that they had different properties on different sides, and that both of them differed from common light as well as from one another. He discovered this difference in the following manner.

Fig. 130.



Having taken two pieces of Iceland spar, he placed them symmetrically, as in fig. 130, with all the faces of the one parallel to all the faces of the other, A *r* X, A′ G X′ being the principal sections of two rhombs. A ray of common light R *r*, incident upon the first crystal at *r*, is divided into two pencils *r* C, *r* D, O being the ordinary and E the extraordinary ray, as formerly explained. Now the ordinary ray D G, falling upon the second crystal at G, and the extraordinary one CF at F, should have been each subdivided, by double refraction, into two pencils, by that crystal; but they are not, the *ordinary* ray D G being *only* refracted *ordinarily*, and the *extraordinary* ray C F *only extraordinarily*, as seen in the figure, where these rays F H, GK, emerge singly at H and K, the one an *ordinary* and the other an *extraordinary* ray. If the upper rhomb remains fixed while the under one is turned round 90°, so that its principal section is perpendicular to that of the upper one, as shown in fig. 131, the same phenomena will take place, with this difference only, that the ray D G refracted *ordinarily* by the *first* crystal, is refracted *extraordinarily* by the *second*, and the ray C F, refracted *extraordinarily* by the *first* crystal, is refracted *ordinarily* by the *second*.

Fig. 131.



Hence it is manifest, that the ray of common light R *r*, and the two doubly refracted pencils C F, D G, have all

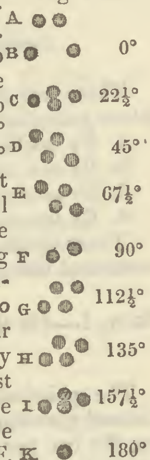
Polarisation.

different properties. For if R r were to fall upon the second rhomb, it would be divided into two pencils; whereas C F and D G refuse to be so divided, and are each refracted in different ways by the second crystal.

Now, in *every other position* of the four rhombs, between the two where their principal sections are *parallel*, or *perpendicular* to one another, the two pencils C F, D G are divided into two pencils, and *four* separate pencils emerge from the second rhomb.

In order to understand the phenomena presented by these *four* pencils, when the second rhomb performs a complete revolution behind the first one, let us suppose that the lower rhomb begins to revolve from the position in fig. 129, which we shall call 0° of azimuth, and in which case we shall have two horizontal pencils H E, K O, fig. 131, whose sections[1] are shown in the annexed figure at B, opposite 0°; A representing the appearance of the aperture through the first rhomb. When the second rhomb has just begun to move out of its position of parallelism to the first, two extremely faint images begin to appear between the other two; and at $22\frac{1}{2}°$ of azimuth they will appear as at C. At 45° of azimuth their intensity will be equal, as at D; at $67\frac{1}{2}°$ the two most distant ones will have become the faintest; and at 90° the four images will be reduced to two, this being the position shown in fig. 130. By continuing to turn the second rhomb, other two faint images start up, which at $112\frac{1}{2}°$ appear as at G; at 135° the four images are equally bright, as at H; at $157\frac{1}{2}°$ the two outermost are the faintest; and at 180° they all coalesce into one bright image, as at K, having twice the brightness of either of those at A or F, and *four* times the brightness of any one of the four at D or H.

Fig. 132.



Malus's law of intensity.

In making the preceding experiment, it will be seen that two of the images gradually increase in brightness, while other two gradually diminish. Malus investigated the law of the intensity for these images, both when the pencil of common light is incident perpendicularly and obliquely. Our limits will permit us to give only the simplest case, making

$o =$ ray refracted *ordinarily* by the *first* rhomb.
$e =$ the ray refracted *extraordinarily* by the *first* rhomb.
$oo =$ the ray refracted *ordinarily* by the *first* rhomb, and *ordinarily* by the *second*.
$oe =$ the ray refracted *ordinarily* by the *first* rhomb, and *extraordinarily* by the *second*.
$ee =$ the ray refracted *extraordinarily* by the *first* rhomb, and *extraordinarily* by the *second*.
$eo =$ the ray refracted *extraordinarily* by the *first* rhomb, and *ordinarily* by the *second*.
$Q =$ the quantity of light contained in the incident ray.
$(1-m)\,Q =$ the quantity of light absorbed by the first rhomb.
$P =$ the intensity of any of the pencils.
$P_o =$ the intensity of the *ordinary* emergent ray.
$P_e =$ the intensity of the *extraordinary* emergent ray.

Then, since the quantity of light contained in the two emergent rays is equal to the incident light diminished by the quantity absorbed, we shall have $Q-(1-m)\,Q = m\,Q$; and since the light is equally divided between the two pencils, we obtain $P_o = \frac{1}{2} m\,Q$, and $P_e = \frac{1}{2} m\,Q$.

But the quantity of light $m\,Q$ which falls upon the second rhomb will be reduced by absorption to $m\,Q-(1-m)\,m\,Q = m^2 Q$; consequently, if a is the angle formed by the principal sections of the two rhombs, we shall have

First pencil, $P_{oo} = \frac{1}{2}\,(m^2\,Q \cos.^2 a)$.
Third pencil, $P_{ee} = \frac{1}{2}\,(m^2\,Q \cos.^2 a)$.
Second pencil, $P_{oe} = \frac{1}{2}\,(m^2\,Q \sin.^2 a)$.
Fourth pencil, $P_{eo} = \frac{1}{2}\,(m^2\,Q \sin.^2 a)$.

When the principal sections of the two rhombs are parallel, then $a = 0$, and $\sin.^2 a = 0$, consequently $P_{oe} = 0$, and $P_{eo} = 0$; that is, *the third and fourth pencils will disappear.*

When, on the contrary, the principal sections are at right angles to one another, $a = 90°$, and $\cos.^2 a = 0$, consequently $P_{oo} = 0$, and $P_{ee} = 0$; that is, *the first and second pencils will disappear.*

When the incident ray is not perpendicular to the surface of the first rhomb, the intensities of the pencils are functions of the angles of incidence and the angle which the ray forms with the principal sections.

All the phenomena above described may be produced by combining any two *positive* and any two *negative* crystals; but if a positive is combined with a negative crystal, the same effects will be produced when the principal sections are at right angles to each other, as when they are parallel in the other cases.

The difference between common and polarised light, as evinced by the phenomena of double refraction, is, that the former may always be divided into two pencils by a doubly-refracting crystal, whereas the latter is not capable of being so divided under certain circumstances.

As the four polarised pencils, when united, as at K, fig. 132, produce a pencil of common light, or rather a pencil which cannot be distinguished from common light, it is highly probable that the Iceland spar, in converting common into polarised light, by refracting it into two pencils, has not communicated to it any new property, but has merely separated it into its two elements, just as a prism separates a pencil of white light into its seven elementary colours by refraction, these colours again forming white light by their reunion.

Sect. II.—*On the Polarisation of Light by Reflection.*

We have already stated, in the history of Optics, the manner in which the celebrated French philosopher Malus discovered the polarisation of light by reflection. Upon repeating his experiments with a variety of opaque and transparent bodies, not metallic, such as glass, water, &c. he found that, *when light was reflected at a particular angle from such bodies, it was polarised exactly like one of the pencils formed by double refraction*, the pencil polarised by reflection having all its properties identically the same with that of the doubly-refracting crystal. Like the latter, it was no longer capable of being divided into *two* pencils by a rhomb of Iceland spar; and as, in the polarisation of light by the double refraction of one crystal, that property depends on the angle formed between the principal sections of the two crystals, as shown in figs. 130 and 131, so, in the present case, the polarisation depends on the angle formed between *the plane of reflection* and that of the principal section of the crystal which polarises the light. In all such phenomena, indeed, as Malus remarks, the *plane of reflection* replaces the plane of the principal section of the crystal.

If we receive the ray polarised by reflection from water at an angle of 52° 45′, upon any crystal having double refraction, it will not be divided into two pencils when the plane of reflection is parallel to the principal section, as if it had been a pencil of common light; but it will be refracted entirely, according to the ordinary law, as if the crystal had lost the power of double refraction. If, on the other

[1] If we place a circular aperture, the size of the little dark circles in fig. 132, at r, the images will have that form.

[Polarisation.] hand, the principal section of the crystal is perpendicular to the plane of reflection, the reflected ray will be refracted wholly, according to the law of extraordinary refraction. In all intermediate positions it will be divided into two rays, according to the same law, and in the same proportions, as if it had acquired its new character by the influence of double refraction.

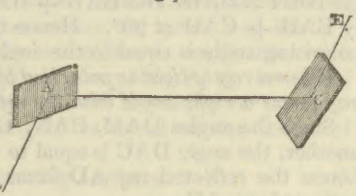
In order to analyse this phenomenon completely, he placed the principal section of a crystal vertically; and after having divided a ray into two by it, he made these two rays fall on the surface of *water*, at an angle of 52° 45′. The ordinary ray was partially reflected, like common light, but *the extraordinary ray penetrated the water wholly, and not a single particle of it was reflected.* When the principal section of the crystal was, on the contrary, perpendicular to the plane of incidence, the *extraordinary* ray was partially reflected, and *the ordinary ray was wholly refracted.*

Malus found the phenomena to be the same for all other transparent bodies, whether solid or fluid; but the angle at which light experienced this modification was in general greater in bodies which refracted light most. Below and above this limit the rays were more or less modified.

This property of reflected light takes place at a different angle for pencils reflected at the *second surfaces* of bodies, and the sine of the angle at the first surface is to the sine of the angle at the second, as the sine of incidence is to the sine of refraction. Hence, in parallel plates, either of glass or other bodies, the two pencils which are reflected in the same directions from both surfaces have equally received this new property, and the light which has received it is said to have been *polarised by reflection.*[1] M. Malus found the same property in black bodies, such as *black marble, ebony*, &c.[2]

Malus next proceeded to study the phenomena when the light R, polarised by one plate of glass A, was reflected from a second plate C, fig. 133, the ray RA being incident on the first plate, and the polarised ray AC on the second plate at an angle of 56°, the polarising angle of glass. In the case shown in the figure, the plane of reflection ACE, in the plate C, is at right angles to the plane of reflection RAC from the first plate, and in this case the reflected pencil CE wholly vanished, all the reflected and polarised light AC having penetrated the glass at C. If we now turn round the plate C from this point, or *zero*, into different azimuths, so that it is always equally inclined to the polarised ray, a small portion of the ray AC will be reflected from C, and this portion will increase till it becomes a maximum, when the plane ACE is parallel to RAC, or in the azimuth of 90°. By continuing to turn the plate C, the reflected ray CE will gradually diminish, and when C has reached the azimuth of 180° its plane of reflection will be perpendicular to that of A, and the reflected ray CE will wholly disappear. In advancing from 180° to 270°, CE will again reach its maximum, and at 360°, when it has returned to its position, as in the figure, it will again return to its minimum.

Fig. 133.



While the reflected pencil CE passes from its *minimum* intensity at 0° and 180°, to its maximum at 90° and 270°, Malus supposes the intensity to vary as the square of the cosine of the angle of azimuth, or of any even power of the cosine. Calling a the angle of azimuth which the plane of the second reflection makes with a plane perpendicular to RAC, I the maximum intensity of the reflected pencil, and P the intensity corresponding to any azimuth a, then $P = I \cos.^2 a$. If we make a equal to 0°, 90°, 180°, and 270°, we shall have, when $a = 0°$, $\cos. a = 1$, $\cos.^2 a = 1$, $\cos.^4 a = 1$, and consequently $P = I$, or the reflected pencil is a maximum. When $a = 90°$, $\cos. a = 0$, $\cos.^2 a = 0$, $\cos.^4 a = 0$, and $F = 0$, that is, the reflected pencil wholly disappears.

It is obvious, from the arrangement of glasses in fig. 132, that, if the light R proceeds from the sky, an observer with his eye placed at E will see a black spot in the part of the sky from which the light R comes, as the whole of the light penetrates the plate C. If the light R comes from a house, the house will disappear if it is at a considerable distance; and by turning round C, the house will have its greatest brightness when the two planes of reflection are parallel. If, in the position when the house was invisible, we breathe upon the plate C, the house will suddenly become visible, and will again disappear when the breath has evaporated. If we now place the plate C at an angle of 52° 45′ to the ray AC, the house will be seen; but if we again breathe upon CC, the house will disappear. The cause of these phenomena is, that by breathing upon C we make the reflecting surface an aqueous one, which refuses to reflect light at an angle of 52° 45′, but reflects it at 56°.

If we place beside each other two sets of reflectors arranged in the manner shown in the figure, C being inclined in the one set 56° to A, and in the other set 52° 45′, and the plates C, C being near each other, we may, by breathing upon each at the same time, exhibit the paradoxical phenomenon of reviving and extinguishing a luminous image by the same breath, or we may appear to breathe at the same time light and darkness.[3]

1. *On the Law of the Polarisation of Light by Reflection.*

After determining the angle at which different bodies polarised light, Malus concluded that "this angle followed neither the order of refractive powers nor that of the dispersive forces, and that it was a property of bodies independent of the other modes of action, which they exercised over light.[4] [Law of polarisation by reflection.]

In repeating the experiments of Malus, Sir David Brewster measured the polarising angles of a greater number of bodies, but experienced many difficulties in connecting them together by a simple law. In some substances the light was not completely polarised at any angle. In others purple and blue light was left at the polarising angles; and in various specimens of glass, different parts of the same surface gave different polarising angles. The first of these phenomena he ascribed to the circumstance that the differently coloured rays of white light were polarised at different angles; and the second he found to arise from changes that had taken place on the surfaces of glass by partial decomposition, owing to the action of the atmosphere. By rejecting those substances where the action of the surface was thus masked or disturbed, he was led to the following general law, that *the index of refraction of any body is the tangent of its angle of polarisation.* [Law of the tangents.]

[1] *Théorie de la Double Refraction*, sect. 48.
[2] *Ibid.* sect. 50.
[3] This experiment was described by Sir David Brewster, in the Edin. Phil. Journal, vol. vii. p. 146. See also his Letters on Natural Magic, p. 125.
[4] *Bull. de Sciences de la Soc. Philos.* Juin 1811, No. 45, tom. ii. p. 294

Polarisation.

The following were the experiments on which this law was founded :—

Names of the Bodies.	Observed Polarising Angles.	Calculated Polarising Angles.
Air	45° or 47°	45° 0′ 32″
Water	52 59[1]	53 11
Fluor spar	54 50	55 9
Obsidian	56 3	56 6
Sulphate of lime	56 28	56 45
Rock crystal	57 22	56 58
Sulphate of barytes	58 29	58 33
Opal-coloured glass	58 1	58 33
Topaz	58 40	58 34
Mother-of-pearl	58 47	58 50
Iceland spar	58 23	58 51
Orange-coloured glass	59 12	59 28
Spinelle ruby	50 6	60 25
Zircon	63 8	63 0
Glass of antimony	64 45	64 30
Sulphur	64 10	63 45
Diamond	68 2	68 1
Chromate of lead	67 42	68 3

Upon repeating these experiments with homogeneous light, our author also found that the angle of polarisation varied with the refrangibility of the light, and that the tangent of the polarising angle was equal to the index of refraction of the light employed.

Hence we are able to explain why, at the maximum polarising angle, a portion of unpolarised light must always remain, and why this portion increases with the refractive and dispersive power of the body. This will be understood from the following table :—

Index of Refraction.	Colour of the Light.	Polarising Angle.	Variation.
Water.			
1·330	Red	53° 4′	0° 15′
1·336	Green, or mean ray	53 11	
1·342	Violet	53 19	
Plate Glass.			
1.515	Red	56 34	0 21
1·525	Green	56 45	
1·535	Violet	56 55	
Oil of Cassia.			
1·597	Red	57 57	1 24
1·642	Green	58 39	
1·687	Violet	59 21	

Now it is obvious, that when the *green* or mean, or most luminous ray, is polarised, and therefore vanishes, neither the red nor the violet has wholly vanished, and consequently a portion of unpolarised light, composed of a portion of these two colours, will still be visible. In oil of cassia the quantity of light is considerable, and is of a fine *blne* colour.

Dr. A. Seebeck's experiments.

So recently as 1830, Dr. A. Seebeck of Berlin has published a series of very accurate and valuable experiments made by an instrument constructed for the purpose, which, if any doubts had existed about the accuracy of the preceding law, were sufficient to remove them. Dr. Seebeck's principal object seems to have been to obtain accurate measures of the polarising angle of different glasses, when the surfaces were newly polished, in order to reconcile the law to that class of bodies in which the deviations had been found to arise from some chemical or mechanical changes produced upon their surface. The following table contains Dr. Seebeck's experiments :—

Names of the Bodies.	Index of Refraction.	Polarising Angles. Observed.	Polarising Angles. Calculated.
Fluor spar, colourless	1·4341	55° 6′·7	55° 6′·7
——— greenish blue	1·4343	55 3·8	55 7·0
Common opal	1·4516	55 29·3	55 26·3
Plate-glass, English, colourless	1·5130	56 36·0	56 32·2
——— colourless	1·5266	56 45·5	56 46·4
Crown-glass, English	1·5321	56 50·2	56 52·0
——— ditto	1·5523	57 12·6	57 12·6
Flint-glass, English	1·5783	57 41·0	57 38·5
——— ditto	1·6206	58 16·6	58 19·4
Pyrope	1·8131	61 4·0	61 7·7
Yellow blende	2·3692	67 8·2	67 7·0

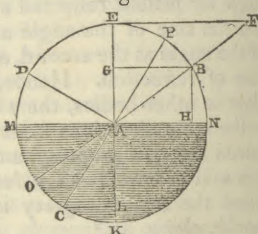
Polarisation.

Upon examining the polarising angles of different specimens of glass at different periods, after the surfaces were polished, Dr. Seebeck confirmed the explanation given by Sir David Brewster, of the variations in their polarising angles.[2]

When a pencil of light is polarised by reflection, the sum of the angles of incidence and refraction is a right angle.

Let MN, fig. 134, be the reflecting surface, and BA a ray of light polarised by reflection in the direction AD, and let AC be the refracted ray. Then, since EF, the tangent of the polarising angle BAE, is equal to m, or the index of refraction, we have, by the law of the sines, $CL = \frac{BG}{m} = \frac{BG}{EF}$. But from the similar triangles ABH, AEF, we have AH, or BG : HB :: EF : rad., and $HB = \frac{BG}{EF}$, consequently $CL = HB$, and the angle BAN = CAK. But EAB + BAN = 90°, consequently EAB + CAK = 90°. Hence the complement of the polarising angle is equal to the angle of refraction.

Fig. 134.



When a ray of light is polarised by reflection, the reflected ray forms a right angle with the refracted ray.

Since the angles DAM, BAN, CAK, are equal to one another, the angle DAC is equal to the right angle MAK; hence the reflected ray AD forms a right angle with the refracted ray AC.

When a pencil of light is incident on the second surface of transparent bodies, at an angle whose cotangent is equal to the index of refraction, the reflected portion will be either wholly polarised, or the quantity of polarised light which it contains will be a maximum.

As the images formed by the first and second surfaces of a transparent plate are simultaneously polarised, this proposition is established by the experimental results in the preceding table.

The angle of polarisation at the second surface of transparent bodies is the complement of the angle of polarisation at the first surface.

As the angle of incidence at the second surface is equal to the angle of refraction at the first surface, and as this latter angle is equal to the complement of the angle of polarisation, it follows that the two polarising angles are complementary to each other.

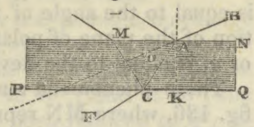
When a ray of light is polarised by reflection from the second surface of transparent bodies, the reflected ray will form a right angle with the refracted ray.

[1] Mean of four observations by Malus, Biot, Arago, and Brewster.
[2] See Poggendorf's *Annalen*, 1830, No. 9, p. 27 ; or Edin. Journ. of Science, N. S. vol. v. p. 99.

Polarisation.

Let AB, fig. 135, be a ray incident at the first surface MN, AD the ray polarised at that surface, AC the ray incident at the second surface PQ, and CM the ray polarised at that surface; then, if CF be the refracted ray, the angle MCF is a right angle. But DAC is a right angle, and on account of the parallelism of MN, PC, and BA, CF, the angle FCP is equal to DAM; but MCP is equal to MAC, hence the whole MCF is equal to the whole DAC, or a right angle.

Fig. 135.



Cor. 1. The ray CM, reflected by the second surface, is at right angles to the ray AB incident on the first surface.

Cor. 2. The internal reflected ray CM forms with the external reflected ray AD, an angle equal to the angle of deviation CAO.

Cor. 3. The ray CF, emerging from the second surface, forms, with the first reflected ray AD, an angle equal to the complement of the angle of deviation.

When a pencil of light is incident upon the separating surface of two media having different indices of refraction m, m′, *it will be polarised at an angle whose tangent is equal to the quotient of the greater index of refraction divided by the lesser, or* $\frac{m}{m'}$, *if* m *exceeds* m′.

This truth is a necessary consequence of the general law, and was also deduced from direct experiment. If the uppermost of the two media is a parallel plate, such as water lying upon a horizontal surface, &c. the separating surface of the two media cannot, at any angle of incidence upon the first surface, completely polarise the incident light, unless the sine of the angle whose tangent is $\frac{m}{m'}$, is, when multiplied by m, less than unity. Thus, in the case of water and glass, the polarising angle is 68° 47′, but no ray incident upon the water, even at 90°, can fall at such an oblique incidence upon the glass as 48° 47′. For sin. 48° 47′ × m' (or the angle of refraction at an incidence of 90°), is = 1·0048. When the upper medium has a higher refractive power than the lower, and lies in a parallel plate upon it, the same law is applicable, with this difference, that the ray is now polarised at the *second surface* of the denser medium, and the angle of polarisation is that whose cotangent is equal to the index of refraction $\frac{m}{m'}$, of the separating surfaces.

Partial polarisation.

In the preceding observations, we have considered only the light which is incident at the polarising angle. It becomes interesting to inquire, what is the condition of the light which is incident at angles above and below the polarising angle. Malus, Arago, Biot, Fresnel, and other distinguished philosophers, considered the light thus reflected as consisting of two pencils, one of which preserved its state of common light, while the other pencil was polarised in the plane of incidence. In the year 1815, however, Sir David Brewster was led, by direct experiments, to a very different opinion, namely, that the pencil of light which was supposed to have preserved its character of common light had *suffered a physical change in its condition, or had acquired in various degrees a character approaching to complete polarisation.* He found, for example, that a pencil of light reflected from glass, either at 62° 30′ or 50° 20′, was so far polarised, that it was wholly polarised by a second reflection at either of these angles; whereas, had the unpolarised part been common light, it could not have been polarised at any angle but 56° 45′. In like manner, he found that *three* reflections at 65° 33′ or 46° 30′, and *four* at 67° 33′ or 43° 51′, polarised the whole pencil; and in general he found *that a ray of light partly polarised by reflection at any angle, will be more and more polarised by every successive reflection in the same plane till its polarisation is complete, whether the reflections are made at angles all above or all below the polarising angle.*

Polarisation.

These views were not acceded to by philosophers, though founded on direct experiment; and, so late as 1825, Sir John Herschel, in discussing the question, gives his decision in favour of the opinion held by the French philosophers.[1] Sir David Brewster was therefore induced to repeat and extend his experiments, and succeeded in establishing his original view of the subject on an impregnable basis. A brief account of these experiments will form the subject of the next section.

2. *On the Motion of the Plane of Polarisation by Reflection.*

Motion of the plane of polarisation.

MM. Fresnel and Arago, and Sir David Brewster, were engaged about the same time in inquiries upon this subject. If we suppose a pencil of polarised light polarised in a plane inclined 45° to a vertical line, and if we reflect it at different angles from a transparent surface in which the plane of reflection is perpendicular to the horizon, the plane of polarisation will be gradually reduced from 45° to 40°, 35°, 30°, 25°, &c. as we diminish the angle of incidence from 90° till we reach the polarising angle, when the plane of polarisation will be inclined 0°, or will be brought into the plane of reflection. At angles less than the polarising angle the plane continues to turn in the same direction, till at 0° it is again inclined 45° to a vertical plane, or to the plane of reflection, having performed a revolution of 90°, the first 45° during the change of incidence from 90° to 56° 45′, and the other 45° from 56° 45′ to 0°.

M. Fresnel represented these changes by the following law: i being the angle of incidence, i' the angle of refraction, x the primitive inclination of the plane of the polarised ray to the plane of reflection, and φ the inclination to which that plane is brought by reflection.

$$\text{Tan.}\,\varphi = \tan.\,x\,\frac{\cos.\,(i+i')}{\cos.\,(i-i')}.$$

When $x = 45°$, tan. $x = 1$, and

$$\tan.\,\varphi = \frac{\cos.\,(i+i')}{\cos.\,(i-i')}.$$

In these formulæ founded on the law of the tangents, $i + i'$ is the supplement of the angle which the reflected ray forms with the refracted ray, while $i - i'$ is the deviation produced by refraction.

The following are the observations with glass and water, with which M. Arago verified the last of these formulæ, in which $x = 45°$.

Glass.

Angles of Incidence.	Inclination of Plane of Polarisation to Plane of Reflection. Observed.	Calculated.	Difference.
24	38° 55′	37° 54′	—1° 1′
39	24 38	24 38	+0 3
49	11 45	10 52	—0 53
60	5 15	5 29	—0 14
70	19 52	20 24	—0 32
80	32 45	33 25	—0 40
85	38 55	39 19	—0 24
87	40 55	41 36	—0 41
88	41 15	42 44	—1 29
89	44 35	43 52	+0 43

[1] Treatise on Light, sect. 866, 867.

Polarisation.

Water.

Angles of Incidence.	Inclination of Plane of Polarisation to Plane of Reflection. Observed.	Calculated.	Difference.
60	10° 20′	10° 51′	—0° 31′
70	25 20	24 48	+0 32
80	36 20	35 49	+0 21
85	40 50	40 32	+0 18

The following observations were made by Sir David Brewster on glass.

Glass.

90°	45° 0′	45° 0′	0° 0′
88	43 4	42 49	+0 35
86	40 43	40 36	+0 7
84	38 47	38 22	+0 25
80	33 13	33 46	—0 33
75	28 45	27 41	+1 4
70	22 6	21 3	+1 3
65	14 40	13 53	+0 47
60	6 10	6 16	—0 6
56	0 0	0 0	0 0
50	9 0	9 0	0 0
45	16 55	16 31	+0 24
40	22 37	23 1	—0 24
30	32 25	33 19	—0 54
20	39 0	40 4	—1 4
10	44 0	43 49	+0 11

Diamond.

90° 0′	45° 0′	45° 0′	0° 0′
85 0	34 30	33 56	+0 34
80 0	24 0	23 12	+0 48
75 0	14 30	13 8	+1 22
70 0	4 30	3 54	+0 36
67 43	0 0	0 0	0 0
60 0	12 30	11 41	+0 49
50 0	24 0	23 30	+0 30

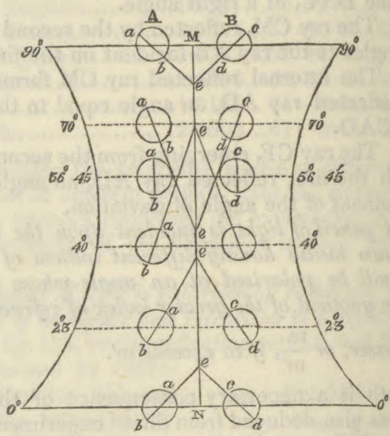
Our author also made another series of experiments, which confirms the general formula. As $x = 45°$ in the preceding experiments, he wished to observe the law of variation for φ when x varied from 0° to 90°. He took a crystal of quartz with a fine natural face parallel to the axis, and he found, that at an angle of incidence of 75°, and when x was $= 45°$, the inclination of the plane of polarisation to the plane of reflection was 26° 20′. We have therefore $\frac{\cos.(i+i')}{\cos.(i-i')} = \tan.\ 26°\ 20'$, and consequently the general formula becomes $\tan.\ \varphi = \tan.\ x.\ \tan.\ 26°\ 20'$, by which the third column in the following table has been calculated.

Values of x.	Inclination of Plane of Polarisation. Observed.	Calculated.	Difference.
0	0° 0′	0° 0′	0° 0′
10	4 54	4 29	+ 0 25
20	10 0	10 16	— 0 16
30	15 50	16 2	— 0 12
35	20 0	19 12	+ 0 48
40	23 30	22 40	+ 0 50
45	26 20	26 27	— 0 7
50	30 0	30 40	— 0 40
55	35 30	35 23	+ 0 7
60	40 0	40 45	— 0 45
70	53 0	53 49	— 0 49
80	70 0	70 29	— 0 29
90	90 0	90 0	0 0

It is a curious circumstance, that at an incidence of 45° the deviation produced by refraction, or $i - i'$, is, *in every substance*, the complement of the angle of refraction i' to 45°; and in the action of all substances in turning round the planes of polarisation, at an incidence of 45°, the angle of rotation, when the plane of the polarised ray is $\pm 45°$, is equal to the angle of refraction, while the new inclination of the plane of polarisation to the plane of reflection, or φ, is equal to the deviation $i - i'$.

These phenomena may be represented to the eye as in fig. 136, where MN represents the plane of incidence divided into ninety equal parts, and *ab*, *ab*, *ab* the planes of

Fig. 136.



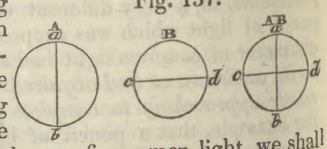
polarisation of the same pencil of light incident at the angles marked upon the curve line. At 90° of incidence, for example, the pencil A has its plane of polarisation inclined 45° to the plane of reflection M; but at 70° the same plane is inclined only 21°, and at 56° it is inclined 0°. At 40° it is inclined 23° in another direction; at 23° about 38°, and at 0° it is inclined 45°.

3. *On the partial Polarisation of Light, and the Law of its Intensity.*

In order to apply these results, Sir David Brewster conceives common light to be composed of two pencils A, B, fig. 136, having their planes of polarisation *ab*, *cd* at right angles to each other, and of equal intensity. Two such pencils united comports itself under all circumstances exactly like common light. We are as much entitled to consider a beam of common light as composed in this manner, as we are to regard white light as composed of seven differently refrangible rays. The prism analyses the one, and doubly-refracting crystals, and the action of transparent surfaces, analyse the other, and common light is recomposed by the two oppositely polarised pencils, as much as white light is recomposed by the union of the seven coloured rays. Considering common light in this manner, Sir David Brewster was led to obtain a complete explanation of the phenomena of polarisation produced by reflexion and refraction.

A beam of common light will be represented as at AB, composed of the two beams A, B, *ab* and *cd* being the planes of polarisation of each of them. In order, however, to analyse the action of a reflecting surface in changing the physical condition of the beam of common light, we shall represent it as in fig. 136, where the planes of polarisation *ab*, *cd* are each inclined 45° to the plane of incidence MN. These two beams are obtained from a rhomb of Iceland spar, upon one of whose surfaces is placed an aperture of the size of A or B, and the rhomb is turned round till its principal section is inclined 45° to the plane of incidence

Fig. 137.



Polarisation.

MN. In this position the double beam or pencil A, B will turn its planes of polarisation as in fig 136.

At an incidence of 90°, or as near it as possible, no change is produced in the pencils A, B, the angle *aec* being still 90°. At an incidence of 80° the angle *aec* is reduced from 90° to 66°; at 70° it has been reduced to 40°; and at 56°, the maximum polarising angle, it has been reduced to 0°, or the planes of polarization *ab*, *cd* being now parallel, or, what is the same thing, the whole of the reflected pencil being polarised in the plane of incidence. Below the polarising angle, the planes *ab*, *cd* continuing to turn in the same direction, are again inclined to each other. At 40° they are inclined 50°; at 23° they are inclined 38°; and at 0°, or a perpendicular incidence, they are again brought back to their primitive inclination of 90°, or the state of common light. The two curves in the figure show the progressive change which takes place in the planes of polarisation, these planes being a tangent to the curve at the incidence which corresponds to any particular part of it.

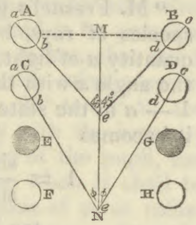
"Such," says Sir David Brewster,[1] "being the action of the reflecting forces upon A and B taken separately, let us now consider them as superposed and forming natural light. At 90° and 0° of incidence, the reflecting force produces no change in the inclination of their axes or planes of polarisation; but at 56° in the case of glass, and 67° 43′ in the case of diamond, the axes of all the particles are brought into a state of parallelism with the plane of reflection; and consequently when the image which they form is viewed by the rhomb of calcareous spar, they will all pass into the ordinary image, and thus prove that they are wholly polarised in the plane of reflection.

"Hence we see that the total polarisation of the reflected pencil at an angle whose tangent is the index of refraction, is effected by turning round the planes of polarisation of one half of the light from right to left, and of the other half from left to right, each through an angle of 45°. Let us now consider what takes place at those angles where the pencil is only partially polarised. At 80°, for example, the angle of the planes *a b*, *c d* is 66°, that is, each plane of polarisation has been turned round in opposite directions from an inclination of 45° to one of 33° with the plane of reflection. The light has therefore suffered a physical change of a very marked kind, constituting now neither natural nor polarised light. It is not natural light, because its planes of polarisation are not rectangular; it is not polarised light, because they are not parallel. It is a pencil of light having the physical character of one half of its rays being polarised at an angle of 66° to the other half. It will now be asked how a pencil thus characterised can exhibit the properties of a partially polarised pencil, that is, of a pencil part of whose light is polarised in the plane of reflection, while the rest retains its condition of natural light. This will be understood by placing the analysing rhomb, with its principal section, in the plane of reflection, and viewing through it the images A and B at 80° of incidence. As the axis of A is inclined 33° to MN or the section of the rhomb, the ordinary image of it will be much brighter than the extraordinary image, the intensity of each being in the ratio of $\cos.^2 \varphi$ to $\sin.^2 \varphi$, φ being the angle of inclination, or 33°, in the present case. In like manner, the ordinary image of B will be in the same ratio brighter than its extraordinary image, that is, by considering A and B in a state of superposition, the extraordinary image of a pencil of light reflected at 80° will be fainter than the ordinary image in the ratio of $\sin.^2 33°$ to $\cos.^2 33°$. But this inequality in the intensity of the two pencils is precisely what would be produced by a compound pencil, part of which is polarised in the plane of reflection, and part of which is common light. When Malus, therefore, and his successors analysed the pencil reflected at 80°, they could not do otherwise than conclude that it was partially polarised, consisting partly of light polarised in the plane of reflection, and partly of natural light. The action of successive reflections, however, afforded a more precise means of analysis, in so far as it proved that the portion of what was deemed natural light had in reality suffered a physical change, which approximated it to the state of polarised light; and we now see that the portion of what was called polarised light was only what may be called apparently polarised; for though it disappears, like polarised light, from the extraordinary image of the analysing prism, yet there is not a single particle of it polarised in the plane of reflection.

"These results lead to conclusions of general importance. The quantity of light which disappears from the extraordinary image, is obviously the quantity of light which is really or apparently polarised at a given angle of incidence; and if we admit the truth of the law of repartition discovered by Malus, and represented by $P_{oo} = P_o \cos.^2 \varphi$, and $P_{oe} = P_o \sin.^2 \varphi$, and as we can determine φ for substances of every refractive power, and for all angles of incidence, we may consider as established the mathematical law which determines the intensity of the polarised pencil, whatever be the nature of the body which reflects it, whatever be the angle at which it is incident, whatever be the number of reflections which it suffers, and whether these reflections are all made from one substance, or partly from one substance and partly from another.

"Let us suppose that a beam of common light composed of two portions A, B (fig. 138) polarised $+ 45°$ and $- 45°$ to the plane of reflection, is incident on a plate of glass at such an angle that the reflected pencil composed of C and D has its planes of polarisation inclined at an angle φ to the plane MN. When a rhomb of calcareous spar has its principal section in the plane MN, it will divide the image C into an extraordinary pencil E and an ordinary one F; and the same will take place with D, G being its extraordinary, and H its ordinary image. If we represent the whole of the reflected pencil, or C + D, by 1, then $C = \frac{1}{2}$, $D = \frac{1}{2}$, $E + F = 1$, and $G + H = 1$. But since the planes of polarisation of C and D are each inclined φ degrees to the principal section of the rhomb, the intensity of the light of the doubly-refracted pencils will be as $\sin.^2 \varphi : \cos.^2 \varphi$; that is, the intensity of E will be $\frac{1}{2} \sin.^2 \varphi$, and that of F, $\frac{1}{2} \cos.^2 \varphi$. Hence it follows that the difference of these pencils, or $\frac{1}{2} \sin.^2 \varphi - \frac{1}{2} \cos.^2 \varphi$, will express the quantity of light which has passed from the extraordinary image E into the ordinary one F; that is, the quantity of light apparently polarised in the plane of reflection MN. But as the same is true of the pencil D, we have $2 (\frac{1}{2} \sin.^2 \varphi - \frac{1}{2} \cos.^2 \varphi)$ or $\sin.^2 \varphi - \cos.^2 \varphi$ for the whole of the polarised light in a pencil of common light C + D. Hence, since $\sin.^2 \varphi + \cos.^2 \varphi = 1$, and $\cos.^2 \varphi = 1 - \sin.^2 \varphi$, we have for the whole quantity of polarised light

Fig. 138.



$$Q = 1 - 2 \sin.^2 \varphi.$$

$$\text{But } \tan. \varphi = \tan. x \frac{\cos. (i + i')}{\cos. (i - i')}$$

$$\text{And as } \tan.^2 \varphi = \frac{\sin.^2 \varphi}{\cos.^2 \varphi}, \text{ and } \sin.^2 \varphi + \cos.^2 \varphi = 1,$$

we have the quotient and the sum of the quantities $\sin.^2 \varphi$ and $\cos.^2 \varphi$, by which we obtain

[1] Phil. Trans. 1830, p. 71.

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$$\sin^2 \phi = \cfrac{1}{\cfrac{1}{\left(\tan. x \dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2 + 1}}$$

$$= \frac{\left(\tan. x \dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2}{1 + \left(\tan. x \dfrac{\cos (i + i')}{\cos. (i - i')}\right)^2}$$

$$\text{That is, } Q = 1 - 2 \frac{\left(\tan. x \dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2}{1 + \left(\tan. x \dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2}$$

"As the quantity of reflected light is here supposed to be 1, we may obtain an expression of Q in terms of the incident light, by adopting the formula of Fresnel for the intensity of a reflected ray. Thus,

$$Q = \tfrac{1}{2} \left(\frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')}\right)$$

$$\times \left(1 - 2 \frac{\left(\dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2}{1 + \left(\dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2}\right).$$

"As $\tan. x = 1$ in common light, it is omitted in the preceding formula.

"This formula may be adapted to partially polarised rays, that is, to light reflected at any angle different from the angle of maximum polarisation, provided we can obtain an expression for the quantity of reflected light.

"M. Fresnel's general formula has been adapted to this species of rays, by considering them as consisting of a quantity a of light completely polarised in a plane making the angle x with that of incidence, and of another quantity $1 - a$ in the state of natural light. Upon this principle it becomes

$$1 = \frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} \cdot \frac{1 + a \cos.^2 x}{2}$$
$$+ \frac{\tan.^2 (i - i')}{\tan.^2 (i - i')} \cdot \frac{1 - a \cos.^2 x}{2}.$$

"But as we have proved that partially polarised rays are rays whose planes of polarisation form an angle of $2x$ with one another as already explained, x being greater or less than 45°, we obtain a simpler expression for the intensity of the reflected pencil, viz. the very same as that for polarised light.

$$1 = \frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} \cos.^2 x + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \sin.^2 x.$$

Hence we have

$$Q = \left(\frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} \cos.^2 x + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \sin.^2 x\right),$$

$$\left(1 - 2 \frac{\left(\tan. x \dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2}{+\left(\tan. x \dfrac{\cos. (i + i')}{\cos. (i - i')}\right)^2}\right).$$

"This formula is equally applicable to a single pencil of polarised light of the same intensity as the pencil of partially polarised light. In all these cases it expresses the quantity of light really or apparently polarised in the plane of reflection.

"In order to show the quantity of light polarised at different angles of incidence, I have computed the following table for common light, and suited to glass in which $m = 1{\cdot}525$.

Angle of Incidence i.	Angle of Refraction i'.	Inclination of Plane of Polarisation to Plane of Reflection, ϕ.	Quantity of Light Reflected out of 1000 Rays.	Quantity of Polarised Light Q.	Ratio of Polarised to Reflected Light.
0° 0′	0° 0′	45° 0′	43·23	0	0
10 0	6 32	43 51	43·39	1·74	0·04000
20 0	12 58	40 13	43·41	7·22	0·16618
25 0	16 5	37 21	43·64	11·6	0·26388
30 0	19 8½	33 40	44·78	17·25	0·3853
35 0	22 6	29 8	46·33	24·37	0·5260
40 0	24 56	23 41	49·10	33·25	0·6773
45 0	27 37½	17 22½	53·66	44·09	0·82167
50 0	30 9	10 18	61·36	57·36	0·9360
56 45	33 15	0 0	79·5	79·5	1·000
60 0	34 36	5 4½	93·31	91·6	0·9628
65 0	36 28	12 45	124·86	112·7	0·90258
70 0	38 2	18 32	162·67	129·80	0·79794
75 0	39 18	26 52	257·26	152·34	0·59154
78 0	39 54	30 44	329·95	457·67	0·47786
79 0	40 4	31 59	359·27	157·69	0·43892
80 0	40 13	33 13	391·7	156·6	0·40000
82 44	40 35	36 22	499·44	145·4	0·29112
84 0	40 42	38 2	560·32	134·93	0·2408
85 0	40 47	39 12	616·28	123·75	0·2008
86 0	40 51	40 22·7	676·26	108·67	0·16068
87 0	40 54	41 32	744·11	89·83	0·12072
88 0	40 57½	42 42	819·9	65·9	0·0804
89 0	40 58	43 51	904·81	36·32	0·04014
90 0	40 58	45 0	1000·0	0	0·0000

"As the preceding formula is deduced from principles which have been either established by experiment or confirmed by it, it may be expected to harmonize with the results of observation. At all the limits where the pencil is either wholly polarised or not polarised at all, it of course corresponds with experiment; but though, in so far as I know, there have been no absolute measures taken of the quantity of polarised light at different incidences, yet we are fortunately in possession of a set of experiments by M. Arago, who has ascertained the angles above and below the polarising angle at which glass and water polarise the same proportion of light. In no case has he measured the absolute quantity of the polarised rays; but the comparison of the values of Q at those angles at which he found them in equal proportions, will afford a test of the accuracy of the formula. This comparison is shown in the following table, in which column 1 contains the angles at which the reflecting surface polarises equal proportions of light; column 2 the values of ϕ, or the inclination of the planes of polarisation; and column 3 the intensities of the polarised light computed from the formula.

	Angles of Incidence.	Inclination of Planes of Polarisation to MN, or ϕ.	Proportion of Polarised Light, or Q.
Glass: No. 1.	82° 48′	37° 33′	·2572
	24 18	37 21	·2637
No. 2.	82 5	36 47	·2828
	26 6	36 0	·3090
No. 3.	78 20	32 38	·4186
	29 42	33 1	·4064
Water: No. 4.	86 31	41 54	·1080
	16 12	41 27	·1236

"The agreement of the formula with experiments made with as great accuracy as the subject will admit, must be allowed to be very satisfactory. The differences are within the limits of the errors of observation, as appears from the following table:

	Deviations from Experiment.	Part of the whole Light.
Glass: No. 1.	0·0065	$\frac{1}{154}$
No. 2.	0·0262	$\frac{1}{38}$
No. 3.	0·0122	$\frac{1}{82}$
Water: No. 4.	0·0156	$\frac{1}{64}$

"M. Arago has concluded, from the experiments above stated, that equal proportions of light are polarised at equal angular distances from the angle of complete polarisation. Thus, in glass No. 1, the mean of 82° 48′ and 24° 18′ is 53° 33′, which does not differ widely from the maximum polarising angle, or 55°, which M. Arago considers as the maximum polarising angle of the glass.[1] In order to compare this principle with the formula, I found, that in water No. 4, the angle which polarises almost exactly the same proportion of light as the angle of 86° 31′, is 15° 10′, the value of φ being 41° 54′ at both these angles; but the mean of these is 50° 50′ in place of 53° 11′, so that the rule of M. Arago cannot be regarded as correct, and cannot therefore be employed, as he proposes, to determine the angle of complete polarisation."[2]

4. *On the Law of the Polarisation of Light by successive Reflections.*

We come now to show the application of the preceding law of intensity to the phenomena of the polarisation of light by successive reflections.

"When a pencil of common light," says Sir David Brewster,[3] "has been reflected from a transparent surface, at an angle of 61° 3′, for example, it has experienced such a physical change that its planes of polarisation form an angle of 6° 45′ each with the plane of reflection. When it is incident on another similar surface at the same angle, it is no longer common light, in which $x = 45°$, but it is partially polarised light, in which $x = 6°$ 45′. In computing, therefore, the effect of the second reflection, we must take the general formula $\tan. \varphi = \tan. x \left(\frac{\cos. (i + i')}{\cos. (i - i')}\right)$; but as the value of x is always in the same ratio to the value of φ, however great be the number of reflections, we have $\tan. \theta = \tan.^n \varphi$ for the inclination θ to the plane of reflection produced by any number of reflections n, φ being the inclination for one reflection. Hence, when θ is given by observation, we have $\tan. \varphi = \sqrt[n]{\theta}$. The formula for any number n of reflections is therefore $\tan. \theta = \left(\frac{\cos. (i + i')}{\cos. (i + i')}\right)^n$. It is evident that θ never can become equal to 0°; that is, that the pencil cannot be so completely polarised by any number of reflections at angles different from the polarising angle, as it is by a single reflection at the polarising angle; but we shall see that the polarisation is sensibly complete, in consequence of the near approximation of θ to 0°.

"I found, for example, that light was polarised by two reflections from glass at an angle of 61° 3′, and 60° 28′ by another observation. Now, in these cases, we have

	θ after 1st Reflection.	θ after 2d Reflection.	Quantity of Unpolarised Light.
two reflections at 61° 3′	6° 45′	0° 47	0·00037
60 28	5 38	0 33	0·00018

The quantity of unpolarised light is here so small as to be quite unappreciable with ordinary lights.

"In like manner, I found that light was completely polarised by five reflections at 70°. Hence, by the formula, we have

	Values of θ.	Unpolarised Light.
1 reflection at 70°	20° 0′	0·23392
2	7 32	0·03432
3	2 45	0·00460
4	1 0	0·00060
5	0 22	0·00008

The quantity of unpolarised light is here also unappreciable after the fifth reflection.

In another experiment it was found that light was wholly polarised by the separating surface of glass and water at the following angles:

	Values of θ.	Unpolarised Light.
By 2 reflections at 44° 51′	0° 56′	0·0005
By 3 42 27	0 26	0·0001

"In all these cases the successive reflections were made at the same angle; but the formula is equally applicable to reflections at different angles,—

"1. When both the angles are greater than the polarising angle,—

	θ.	Unpolarised Light.
1 reflection at 58° 2′, and 1 at 67° 2′	0° 34′	0·0002

"2. When one of the angles is above and the other below the polarising angle,—

	θ.	Unpolarised Light.
1 reflection at 53°, and 1 at 58° 2′	0° 12′	0·000024

This experiment requires a very intense light; for I find in my journal that the light of a candle is polarised at 53° and 78°.

"In reflections at different angles, the formula becomes $\tan. = \frac{\cos. (i + i')}{\cos. (i - i')} \times \frac{\cos. (\mathrm{I} + \mathrm{I}')}{\cos. (\mathrm{I} + \mathrm{I}')}$, I and i being the angles of incidence. In like manner, if a, b, c, d, e, &c. are the values of φ or θ for each reflection, or rather for each angle of incidence, we shall have the final angle, or $\tan. \theta = \tan. a \times \tan. b \times \tan. c \times \tan. d$, &c.

"It is scarcely necessary to inform the reader, that when a pencil of light reflected at 58° 2′ is said to be polarized by another reflection at 67° 2′, it only means, that this is the angle at which complete polarisation takes place in diminishing the angle gradually from 90° to 67° 2′, and that even this angle of 67° 2′ will vary with the intensity of the original pencil, with the opening of the pupil, and with the sensibility of the retina. But when it shall be determined experimentally at what value of φ, or rather at what value of Q, the light entirely disappears from the extraordinary image, we shall be able, by inverting the formula, to ascertain the exact number of reflections by which a given pencil of light shall be wholly polarised.

"As the value of Q depends on the relation of i and i', that is, on the index of refraction, and as this index varies for the different colours of the spectrum, it is obvious that Q will have different values for these different colours. The consequence of this must be, that in bodies of high dispersive powers, the unpolarised light which remains in the extraordinary image, and also the light which forms the ordinary image, must be coloured at all incidences; the colours being most distinct near the maximum polarising angle. This necessary result of the formula was found to be experimentally true in oil of cassia, and various highly dispersive bodies. In realgar, for example, φ is $= 0$ at an angle of 69° 0′ for blue light, at 68° 37′ for green light, and at 66° 49′ for red light. Hence there can be no angle of complete polarisation for white light, which was also found to be the case by experiment; and as Q must at different angles of incidence have different values for the different rays, the unpolarised light must be composed of a certain portion of each different colour, which may be easily determined by the formula.

"Such are the laws which regulate the polarisation of

[1] Hence we have assumed $m = 1·428$, the tangent of 55°, in the preceding calculations.
[2] It is obvious that the rule can only be true when $m = 1·000$; so that its error increases with the refractive power.
[3] Phil. Trans. 1830, p. 80.

Polarisation.

light by reflection from the first surfaces of bodies that are not metallic. The very same laws are applicable to their second surfaces, provided that the incident light has not suffered previous or subsequent refraction from the first surface. The sine of the angle at which φ or Q has a certain value by reflection from the second surface, is to the sine of the angle at which they have the same value at the first surface, as unity is to the index of refraction. Hence φ and Q may be determined by the preceding formulæ after any number of reflections, even if some of the reflections are made from the first surface of one body and the second surface of another."

Sect. III.—*On the Polarisation of Light by Refraction.*

We have already seen that the polarisation of light by refraction was discovered by independent observations by Malus, Biot, and Brewster; but the priority of discovery belongs to Malus, who, from various observations, arrived at the following conclusion: "When a ray of light falls upon a plate of glass at an angle of 54° 35′, all the light which it reflects is polarised in one direction. The light which traverses the glass is composed, 1*st*, of a quantity of light polarised in a direction opposite to that which is reflected, and proportional to it; and, 2*dly*, of another portion not modified, and which preserves the character of direct light."

Sir David Brewster made analogous experiments with thin films of glass, films of mica, folds of gold-beaters' skin, and films of gold leaf; but he occupied himself chiefly in determining the law of the phenomena depending on the number of plates through which the light was transmitted, and found *that the number of plates which polarise a maximum of light by transmission at different angles of incidence, are to one another as the co-tangents of the angles of incidence.*

In determining this law, our author employed forty-seven plates of crown-glass, each about three inches long and one broad, and with these he obtained the following results:—

Number of Plates in each Parcel.	Angles of Incidence at which Light is Polarised, by Calculation.	Angles of Incidence at which Light is Polarised, by Experiment.	Differences between the Calculated and Observed Angles.
8	79° 11′	78° 52′ [1]	0 19′ —
10	76 33	76 24	0 9 —
12	74 0	74 2	0 2 +
14	71 30	72 15	0 45 +
16	69 4	69 40	0 36 +
18	66 43	66 43	0 0
21	63 21	63 39	0 18 +
24	60 8	61 0	0 52 +
27	57 10	56 58	0 12 —
29	55 16	54 50	0 26 —
31	53 28	53 16	0 12 —
33	51 44	51 0	0 44 —
35	50 5	50 23	0 18 +
39	47 1	46 50	0 11 —
41	45 35	45 49	0 14 +
44	43 34	44 0	0 26 +
47	41 41	42 0	0 19 +
100	22 42		
200	11 49		
500	4 47		
1,000	2 24		
2,000	1 12		
4,000	0 36		
14,000	0 1		
8,640,000	0 0 1″		

[1] This result was obtained by a parcel of plates of parallel glass.

If n, n', therefore, represent the number of plates in any two parcels, and φ, φ the angles at which the pencil was polarised, we have

$$n : n' = \text{cotan. } \varphi : \text{cotan. } \varphi', \text{ and}$$
$$n \times \text{tan. } \varphi = n' \times \text{tan. } \varphi'.$$

That is, the *number of plates in any parcel, multiplied by the tangent of the angle at which it polarises light, is a constant quantity.* From a great number of observations made with a parcel of eighteen plates, our author found the constant quantity for crown-glass to be 41·84 when the light was that of a good wax-candle placed at the distance of about twelve feet, so that we have

$$\text{tan. } \varphi = \frac{41{\cdot}84}{n};$$

that is, divide the constant quantity by any given number of plates, and the quotient will be the natural tangent of the angle at which that number will polarise a pencil of light.

In this way the *second* column of the table, which differs very little from the observed column, was computed.

From these experiments our author drew the same conclusion as in the case of reflection, respecting the state of what Malus calls the unpolarised light, namely, that it had suffered a physical change; and he also showed that light could be polarised by successive refractions, each refraction bringing it gradually nearer and nearer to the state of complete polarisation.

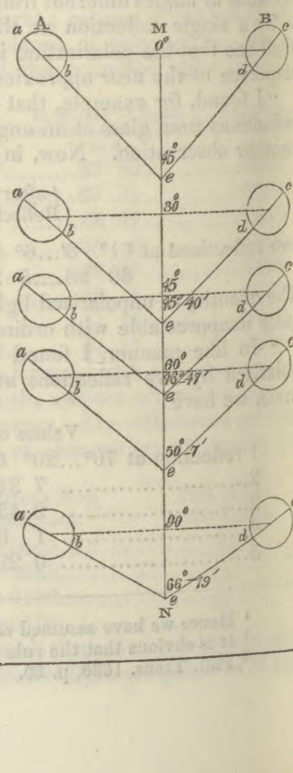
1. *On the Motion of the Planes of Polarisation by Refraction.*

The first, and we believe the only, experiments that have been made on this subject, were those of Sir David Brewster;[1] and we shall therefore give an account of his researches in his own words, abridging it as much as possible.

"If we take a plate of glass, deviating so slightly from parallelism between it faces as to throw aside from the direct transmitted image of a luminous body the faint images formed by reflection between its inner surfaces, we shall obtain, even at the greatest obliquities, a pencil of light free of all admixture of reflected light.

"Let this plate be placed upon a divided circle, so that we can observe through it two luminous discs of polarised light A, B (fig. 139) formed by double refraction, and having their planes of polarisation inclined + 45° and — 45° to the plane of refraction. At a perpendicular incidence, the inclination of the planes of polarisation will suffer no change; but at an incidence of 30° they will be turned round 40′, so that their inclination to MN or the angle *aec* will be 45° 40′. At 45° their inclination will be 46° 47′. At 60° it will be 50° 7′; and it will increase gradually to 90°, where it becomes 66° 19′. Hence the maximum change produced by a single plate of glass upon the planes of polarisation is 66° 19′—45° = 21° 19′, an effect exactly equal to

Fig. 139.



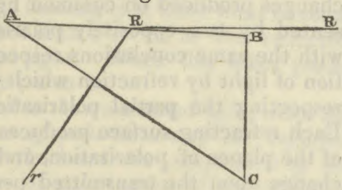
[1] Phil. Trans. 1830, p. 133.

what is produced by reflection at angles of 39° or 70°. It is remarkable, however, *that this change is made in the opposite direction, the planes of polarisation now approaching to coincidence in a plane at right angles to that of reflection* ; a difference which might have been expected from the opposite character of the resulting polarisation.

"In this experiment the action of the two surfaces is developed in succession, so that we cannot deduce from the maximum rotation of 21° 19′, the real action of the first, or of a single surface, which must be obviously more than half of the action of the two surfaces, because the planes of polarisation have been widened before they undergo the action of the second surface.

"In order to obtain the rotation due to a single surface, I took a prism of glass ABC, having such an angle BAC, that a ray RR, incident as obliquely as possible, should emerge in a direction Rr perpendicular to the surface AC. I took care that this prism was well annealed, and I caused the refraction to be performed as near as possible to the vertex A, where the glass was thinnest, and consequently most free from the influence of any polarising structure. In this way I obtained the following measures.

Fig. 140.



Glass.

Angles of Incidence.	Inclination of Planes *ab, cd*, to the Plane of Reflection.	Rotation of Plane for one Surface.
87° 38′	54° 15′	9° 15′
54 50	47 25	2 25
32 20	45 22	0 22

"I next made the following experiments with two kinds of glass, the one a piece of parallel plate-glass, and the other a piece of very thin crown. The latter had the advantage of separating the reflected from the transmitted light.

	Plate Glass.		*Crown Glass.*	
Incidence.	Inclination.	Rotation for two Surfaces.	Inclination.	Rotation for two Surfaces.
0°	45° 0′	0° 0′	45° 0′	0° 0′
40	47 28	2 28	47 18	2 18
55	49 35	4 35	49 19	4 19
67	52 53	7 53	58 16	7 16
80	58 53	13 53	58 42	13 42
86½	61 16	16 16	61 0	16 0

"In order to ascertain the influence of refractive power, I stretched a film of soapy water across a rectangular frame of copper wire, and obtained the following measures:

Water.

Incidence.	Inclination.	Rotation.
85°	54° 17′	9° 17′

Metalline Glass.

0	45 0	0 0
20	45 42	0 42
30	46 50	1 50
40	48 0	3 0
55	51 12	6 12
80	62 32	17 32

"From a comparison of these results, it is manifest that *the rotation increases with the refractive power.*

"In examining the effects produced at different incidences, it is obvious that the rotation R varies with the deviation of the refracted ray; that is, with $i - i'$. Hence I have been led to express the inclination φ of the planes of polarisation to the plane of refraction and the rotation by the formulæ

$$\cot. \varphi = \cos. (i - i'), \qquad R = \varphi - 45°.$$

"This formula represents the experiments so accurately, that when the rhomb of calcareous spar is set to the calculated angle of inclination, the extraordinary image is completely invisible.

"The above expression is of course suited only to the case where the inclination x of the planes of polarisation *ab, cd* (fig. 139), is 45°; but when this is not the case, the general expression is

$$\cot. \theta = \cot. x \cos. (i - i').$$

"When the light passes through a second surface, as in a single plate of glass, the value of x for the second surface is evidently the value of φ after the first refraction; or, in general, calling θ the inclination after any number n of refractions, and φ the inclination after one refraction,

$$\cot. \theta = (\cot. \varphi)^n.$$

"When θ is given by observation we have

$$\cot. \varphi = \sqrt[n]{\cot. \theta}.$$

"The general formula for any inclination x and any number n of refractions is

$$\cot. \theta = \big(\cot. x \cos. (i - i')\big)^n, \text{ and}$$

$$\cot. \varphi = \sqrt[n]{\cot. x \cos. (i - i')}.$$

"And when $x = 45$ and $\cot. x = 1$, as in common light,

$$\cot. \theta = \big(\cos. (i - i')\big)^n,$$

$$\cot. \varphi = \sqrt[n]{\cos. (i - i')}.$$

"As the term $\big(\cos. (i - i')\big)^n$ can never become equal to 0, the planes of polarisation can never be brought into a state of coincidence in a plane perpendicular to that of reflection.

"In order to compare the formula with experiment, I took a plate of well-annealed glass, which at all incidences separates the reflected from the transmitted rays, and in which m was nearly 1·510, and I obtained the following results:

Angles of Incidence.	Angles of Refraction.	Rotation observed.	Inclination observed.	Inclination calculated.	Difference.
0°	0° 0′	0° 0′	45° 0′	45° 0′	
10	6 36½	0 13	45 13	45 6	+0° 7′
20	13 5	0 27	45 27	45 25	+0 2
25	16 15	0 32	45 32	45 40	−0 8
30	19 20	0 40	45 40	46 0	−0 20
35	22 19	1 12	46 12	46 25	−0 13
40	25 10	1 30	46 30	46 56	−0 26
45	27 55	1 42	46 47	47 34	+0 47
50	30 29	2 48	47 42	48 24	−0 42
55	33 52	3 54	48 54	48 59	−0 5
60	35 0	5 7	50 7	50 36	−0 29
65	36 53	6 48	51 48	52 7	−0 19
70	38 29	8 7	53 7	53 59	−0 52
75	39 45	9 55	54 55	56 18	−1 23
80	40 42	12 10	57 10	59 5	−1 55
85	41 19	15 45	60 45	62 24	−1 39
86	41 21	16 39	61 39	63 9	−1 30
90	41 28			66 19	

"The last column but one of the table was calculated by the formula

$$\cot. \theta = \cos. \big(\cos. (i - i')\big)^2,$$

n being in this case 2. The errors, however, being almost all negative, I suspected that there was an error of adjustment in the apparatus; and upon repeating the experiment at 80°, the point of maximum error, I found that the inclination was fully 58° 40′, giving a difference only of 25 in place of 1° 55′.

"In these experiments $x = 45°$ and $\cot. x = 1$; but in order to try the general formula when x varied from 0° to 90°, I took the case where the angle of incidence was 80°,

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and $\varphi = 58° 40'$ when $x = 45°$. The following were the results.

Values of x.	Inclination observed.	Inclination calculated.	Difference.
0°	0° 0′	0° 0′	0° 0′
$2\frac{1}{2}$	7 10	7 20	— 0 10
5	9 40	8 19	+ 1 21
10	17 10	16 25	+ 0 45
15	24 42	24 6	+ 0 36
20	32 30	31 19	+ 1 11
25	39 15	37 54	+ 1 21
30	44 10	43 57	+ 0 13
35	49 38	49 28	+ 0 10
40	54 36	54 31	+ 0 5
45	58 40	59 5	— 0 25
50	63 10	63 19	— 0 9
55	66 58	67 15	— 0 17
60	70 18	70 56	— 0 38
65	74 8	74 24	— 0 16
70	76 56	77 42	— 0 46
75	79 20	80 53	— 1 33
80	83 23	83 58	— 0 35
85	86 23	86 0	+ 0 23
90	90 0	90 0	0 0

"The last column but one was calculated by the formula $\cot. \theta = \cot. x \,.\, (\cot. 58° 40')^2$.

"In determining the quantity of polarised light in the refracted pencil, we must follow the method already explained for the reflected ray, *mutatis mutandis.* The principal section of the analysing rhomb being now supposed to be placed in a plane perpendicular to the plane of reflection, the quantity of light Q′ polarised in that plane will be

$$Q' = 1 - 2 \cos.^2 \varphi,$$

the quantity of transmitted light being unity. But

$$\cot. \varphi = \cot. x \cos. (i - i'),$$

and as $\cot. \varphi = \frac{\cos.^2 \varphi}{\sin.^2 \varphi}$, and $\sin.^2 \varphi + \cos.^2 \varphi = 1$, we have the quotient and the sum of $\sin.^2 \varphi$ and $\cos.^2 \varphi$ to find them.

$$\text{Hence } \cos.^2 \varphi = \frac{(\cot. x \cos. (i - i'))^2}{1 + (\cot. x \cos. (i - i'))^2};$$

and by substituting this for $\cos.^2 \varphi$ in the former equation, it becomes

$$Q' = 1 - 2 \frac{(\cot. x \cos. (i - i'))^2}{1 + (\cot. x. \cos. (i - i'))^2}.$$

"Now since, by Fresnel's formula, the quantity of reflected light is

$$R = \tfrac{1}{2} \left(\frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \right),$$

the quantity of transmitted light T will be

$$T = 1 - \tfrac{1}{2} \left(\frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \right).$$

$$\text{Hence } Q' = \left(1 - \tfrac{1}{2} \left(\frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \right) \right)$$

$$\left(1 - 2 \frac{(\cos. (i - i'))^2}{1 + (\cos. (i - i'))^2} \right).$$

"This formula is applicable to common light, in which $\cot. x = 1$ disappears from the equation; but, on the same principles which we have explained in a preceding paper, it becomes for partially polarised rays and for polarised light,

$$Q' = \left(1 - \tfrac{1}{2} \left(\frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} \cos.^2 x + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \sin.^2 x \right) \right)$$

$$\left(1 - 2 \frac{(\cot. x \cos. (i - i'))^2}{1 + (\cot. x \cos. (i - i'))^2} \right).$$

"In all these cases the formula expresses the quantity of light really or apparently polarised in the plane of refraction.

"As the planes of polarisation of a pencil polarised + 45° and — 45° cannot be brought into a state of coincidence by refraction, the quantity of light polarised by refraction can never be mathematically equal to the whole of the transmitted pencil, however numerous be the refractions which it undergoes; or, what is the same thing, refraction cannot produce rays truly polarised, that is, with their planes of polarisation parallel."

2. *On the partial Polarisation of Light by one or more Refractions.*

"The analysis given in the preceding paragraphs, of the changes produced on common light, considered as represented by two oppositely polarised pencils, furnishes us with the same conclusions respecting the partial polarisation of light by refraction which we have already deduced respecting the partial polarisation of light by reflection. Each refracting surface produces a change in the position of the planes of polarisation, and consequently a physical change upon the transmitted pencil by which it has approached to the state of complete polarisation.

"This position I shall illustrate by applying the formula to the experiments in a preceding page.

"According to the first of these, the light of a wax-candle at the distance of ten or twelve feet is wholly polarised by eight plates or sixteen surfaces of parallel plate-glass at an angle of 78° 52′. Now I have ascertained that a pencil of light of this intensity will disappear from the extraordinary image, or appear to be completely polarised, provided its planes of polarisation do not form an angle of less than $88\frac{3}{4}°$ with the plane of refraction for a moderate number of plates, or $88\frac{1}{2}°$ for a considerable number of plates, the difference arising from the great diminution of the light in passing through the substance of the glass. In the present case the formula gives

$$\cot. \theta = (\cos. (i - i'))^{16} \text{ and } \theta = 88° 50';$$

so that the light should appear to be completely polarised, as it was found to be.

"At an angle of 61° 0′ the pencil was polarised by twenty-four plates or forty-eight surfaces. Here

$$\cot. \theta = (\cos. (i - i'))^{48} = 89° 36'.$$

"At an angle of 43° 34′ the light was polarised by forty-seven plates or ninety-four surfaces. Here

$$\cot. \theta = (\cos. (i - i'))^{94} \text{ and } \theta = 88° 27'.$$

"It is needless to carry this comparison any further; but it may be interesting to ascertain by the formula the smallest number of refractions which will produce complete polarisation. In this case the angle of incidence must be 90°.

"Hence, $\varphi = 56° 29'$ and $(\cos. (i - i'))^9$ gives 88° 36′, and $(\cos. (i - i'))^{10}$ 89° 4′; that is, the polarisation will be nearly complete by the most oblique transmission through four and a half plates or nine surfaces, and will be perfectly complete through five plates or ten surfaces."

Sect. IV.—*Comparison of the Laws of Intensity for Light polarised by Reflection and Refraction.*

"Having obtained formulæ for the quantity of light polarised by refraction and reflection, it becomes a point of great importance to compare the results which they furnish. Calling R the reflected light, these formulæ become

$$Q = R\left(1 - 2\frac{\left(\frac{\cos.(i+i')}{\cos.(i-i')}\right)^2}{1+\left(\frac{\cos.(i+i')}{\cos.(i-i')}\right)^2}\right), \text{ and}$$

$$Q' = 1 - R\left(1 - 2\frac{(\cos.(i-i'))^2}{\varphi + (\cos.(i-i'))^2}\right).$$

"But these two quantities are equal, and hencc we obtain the important general law, that,—*At the first surface of all bodies, and at all angles of incidence, the quantity of light polarised by refraction is equal to the quantity polarised by reflection. I have said 'of all bodies,' because the law is equally applicable to the surfaces of crystallized and metallic bodies, though the action of their first surface is masked or modified by other causes.*

"It is obvious from the formula that there must be some angle of incidence where $R = 1 - R$, or the reflected equal to the transmitted light. When this takes place, we have $\sin.^2\varphi = \cos.^2\varphi'$; that is,

"*The reflected is equal to the transmitted light, when the inclination of the planes of polarisation of the reflected pencil to the plane of reflection, is the complement of the inclination of the planes of polarisation of the refracted pencil to the same plane;* or, if we refer the inclination of the planes to the two rectangular planes into which the planes of polarisation are brought,—*The reflected will be equal to the transmitted light when the inclination of the planes of polarisation of the reflected pencil to the plane of reflection is equal to the inclination of the plane of polarisation of the refracted pencil to a plane perpendicular to the plane of reflection.*

"In the following table, the inclination of the planes of polarisation of the reflected and the refracted pencil, and the quantities of light reflected, transmitted, and polarised, at all angles of incidence upon glass, m being equal to 1·525, and the incident light = 1000, are given:

Angles of Incidence, i.	Angles of Refraction, i'.	Inclination of Plane of Polarisation of the Reflected Light, φ'.	Inclination of Plane of Polarisation of the Refracted Light, φ.	Quantity of Light Reflected, R.	Quantity of Light Transmitted, 1 — R.	Quantity of Light Polarised, Q.
0° 0′	0° 0′	45° 0′	45° 0′	43·23	956·77	0·
2 0	1 18⅔	44 57	45 0·7	43·26	956·74	0·07
10 0	6 32	43 51	45 3	43·39	956·61	1·73
20 0	12 58	40 13	45 13	43·41	956·59	7·22
25 0	16 5	37 21	45 21	43·64	956·36	11·6
30 0	19 8½	33 40	45 31	44·78	955·22	17·24
35 0	22 6	29 8	45 44	46·33	953·67	24·4
40 0	24 56	23 41	46 0	49·10	950·90	32·2
45 0	27 37½	17 22½	46 20	53·66	946·33	44·0
50 0	30 9	10 18	46 45	61·36	938·64	57·4
56 45	33 15	0 0	47 29	79·5	920·5	79 5
60 0	34 36	5 4½	47 54½	93·31	906·69	91·6
65 0	36 28	12 45	48 42	124·86	875·14	112·7
70 0	38 2	18 32	49 28	162·67	837·33	129·8
75 0	39 18	26 52	50 55	257·56	742·44	152·3
78 0	39 54	30 44	51 48	329·95	670·05	157·6
78 7	39 55	30 53	51 50	333·20	666·80	157·65
79 0	40 4	31 59	52 7	359·27	640·73	157·6
80 40	40 13	33 13	52 27½	391·7	608·3	156·7
82 4	40 35	36 22	53 26⅓	499·44	500·56	145·4
84 0	40 42	38 2	53 57	560·32	439·68	134·93
85 0	40 47	39 12	54 22	616·28	383·72	123·7
85 50⅔	40 50⅔	40 12	54 44	666·44	333·56	111·11
86 0	40 51	40 22 7/10	54 48	676·26	323·74	108·67
87 0	40 54	41 32	55 16	744·11	255·89	89·8
88 0	40 57½	41 23	55 43	819·9	180·1	65·9
89 0	40 58	43 51	56 14	904·81	95·19	36·3
90 0	40 58	45 0	56 29	1000·	·0·	0·

"It is obvious, from a consideration of the principle of the formula for reflected light, that the quantity of polarised light is nothing at 0°, because the force which polarises it is there a minimum. At the maximum polarising light, Q is only 79·5, because the glass is incapable of reflecting more light at that angle, otherwise more would have been polarised. The value of Q, then, rises to its maximum at 78° 7′, and descends to its minimum at 90°; but the polarising force has not increased from 56° 45′ to 78° 7′, as the value of φ' shows. It is only the quantity of reflected light that has increased which occasions a greater quantity of light to disappear from the extraordinary image of the analysing rhomb.

"The case, however, is different with tne refracted light. The value of Q′ has one minimum at 0°, and another at 90°, while its maximum is at 78° 7′; while the force has its minimum at 0°, and its minimum at 90°, where its effect is a minimum only because there is no light to polarise. At the incidence of 78° 7′, where the quantities Q, Q′ reach their maxima, the reflected light is exactly one half of the transmitted light; $\sin.^2\varphi' = \cos.^2\varphi$ and $\tan.\varphi' = \cos.\varphi$.

"At 85° 50′ 40″, where the transmitted light is one half of the reflected light, the deviation $(i - i') = 45°$, and the quantity of polarised light is one third of the transmitted light, one sixth of the reflected light, and one ninth of the incident light. $\sin.^2\varphi' : \cos.^2\varphi$ = reflected light : transmitted light, and $\cot.\varphi = \sin.(i - i')$.

"At 45° we have $(i+i')+(i-i')=90°$ and $\varphi'=(i-i')$, $\tan.(i-i')=\frac{\cos.(i+i')}{\cos.(i-i')}$, and $\tan.(i-i')^2=\frac{(\sin.(i-i'))^2}{(\sin.(i+i'))^2}$.

"At 56° 45′, the polarising angle, the formula for reflected light becomes $R = \frac{1}{2}(\sin.^2(i-i'))^2$; but at this angle we have $i' = 90° - i$. Hence we obtain the following simple expression in terms of the angle of incidence, for the quantity of light reflected by all bodies at the polarising angle:

$$R = \tfrac{1}{2}(\cos.2\,i)^2."$$

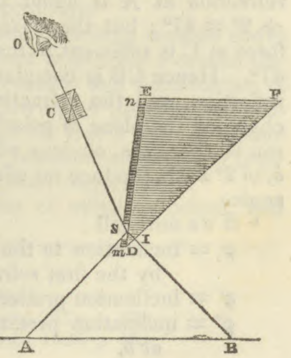
SECT. V.—*On the Action of Single Plates and Single Surfaces in polarising Light by Reflection and Refraction.*

In the article on the *polarisation* of light in this work, M. Arago has described an elegant experiment, from which he deduced the conclusion, that *the quantity of polarised light contained in the pencil transmitted by a transparent plate is exactly equal to the quantity of light polarised at right angles, which is found in the pencil reflected by the same plate.*

Now this law is true only at the maximum polarising angle, the two pencils being unequal at all other angles of incidence. The apparent equality observed by M. Arago seems to have arisen from other light being blended with the pencils. In order, therefore, to obtain the true law for single plates, we must determine it for a *single surface.*

In order to do this, Sir David Brewster employed a well-annealed prism of colourless glass, in place of a plate of glass, and he made the ray BI from a sheet of white paper BA enter the surface FD perpendicularly at I, while another ray AS was reflected to the eye from the surface ED of the prism. He then made the experiment with a doubly refracting prism C in the manner described by M. Arago, and obtained the law for *a single surface*, viz.

Fig. 141.



That the quantity of polarised light in the pencil re-

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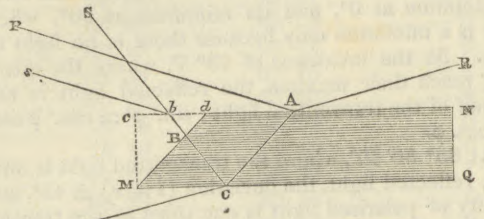
fracted by a transparent surface is exactly equal to the quantity in the pencil reflected by it.

That is, what was supposed to be true of plates is true only of surfaces.

The action of a single plate on light, involving the combined action of three refractions and two reflections, without following the light beyond one internal reflection, is sufficiently complex, and has been analysed in the following manner by Sir David Brewster.

He took a plate of glass of the form MN, fig. 142, having an oblique face Md cut upon one of its ends.

Fig. 142.



" A ray of light RA, polarised + 45° and — 45°, was made to fall upon it at A, at an angle of incidence of nearly 83°, so that the inclination of the planes of polarisation of the reflected ray AP was about $36\frac{1}{2}$°. Now the ray AC, after reflection in the direction CS, without any refraction at B, where it emerges perpendicularly to Md, would also have had the inclination of its planes of polarisation equal to $36\frac{1}{2}$° if there had been no intermediate refraction at A; but this refraction alone being capable of producing an inclination of 53°, or a rotation of 53° — 45° = 8°, and this rotation being in an opposite direction from that produced by the second reflection at C, the inclination of the planes of polarisation for the ray CS is nearly $44\frac{1}{2}$°, the reflection of C having brought back the ray AC almost exactly into the state of natural light.

" Without changing either the light or the angle, I cemented a prism Mcd on the face Md, so that cd was parallel to dN, and I found that the second refraction at b, equal to that at A, changed the inclination of the planes of polarisation to 53°; that is, the two refractive actions at A and b had overcome the action of reflection at C, and the pencil bs actually contained light polarised perpendicular to the plane of reflection.

" In order to put this result to another test, I took a plate Mc NQ (fig. 142) of the same glass, which separated the pencil bs reflected at the second surface, from the parallel pencil AP reflected from the first surface, and I found, that at an angle of 83°, the value of the inclination I or φ for the ray was about $37\frac{1}{2}$°, while the value of I for the ray bs was nearly 55°, an effect almost equal to the refractive action of a plate at 83° of incidence.

" When the pencil RA is incident on the first surface at the polarising angle or 56° 45′, the rotation produced by refraction at A is about 2°, or the inclination I = 45° + 2° = 47°; but the maximum action of the polarising force at C is sufficient to make I = 0° whether x is 45° or 47°. Hence CB is completely polarised in the plane of reflection, and the refractive action at b is incapable of changing the plane of polarisation when I = 0°; the reason is, therefore, obvious why the two rotations at A and b, of 2° each, produce no effect at the maximum polarising angle.

" If we now call

φ = inclination to the plane of reflection produced by the first refraction at A,

φ' = inclination produced by the reflection at C,

φ'' = inclination produced by the second refraction at b,

We shall have

$$\cot.\ \varphi = \cos.\ (i - i'), \text{ or } \tan.\ \varphi = \frac{1}{\cos.(i - i')},$$

$$\tan.\ \varphi' = \tan.\ x\ \frac{\cos.\ (i + i')}{\cos.\ (i - i')} = \frac{\cos.\ (i + i')}{(\cos.\ (i - i'))^2},$$

$$\cot.\ \varphi'' = \cot.\ x\ (\cos.\ (i - i')\ ) = \frac{(\cos.\ (i - i')\ )^3}{\cos.\ (i + i')}$$

" These formulæ are suited to common light, where x = 45°, but when x varies they become

$$\cot.\ \varphi = \cot.\ x\ (\cos.\ (i - i')\ ),$$

$$\tan.\ \varphi' = \tan.\ x\ \left(\frac{\cos.\ (i + i')}{(\cos.\ (i - i')\ )^2}\right),$$

$$\cot.\ \varphi'' = (\cot.\ x\ \left(\frac{(\cos.\ (i - i')\ )^3}{\cos.\ (i + i')}\right).$$

" Resuming the formula for common light, viz. $\cot.\ \varphi' = \dfrac{(\cos.\ (i - i')\ )^3}{\cos.\ (i + i')}$, it is obvious that when $(\cos.\ (i - i')\ )^3 = \cos.\ (i + i')$, $\cot.\ \varphi'' = 1$, and $\varphi'' = 45°$; that is, the light is restored to common light.

" In glass where m = 1·525 this effect takes place at 78° 7′, a little below 78° in diamond, and a little above 80° in water.

" At an angle below this φ becomes less than 45°, and the pencil contains light polarised in the plane of reflection; while at all greater angles φ is above 45°, and the pencil contains light polarised perpendicular to the plane of reflection. Hence we obtain the following curious law:

" ' *A pencil of light reflected from the second surfaces of transparent plates, and reaching the eye after two refractions and an intermediate reflection, contains, at all angles of incidence, from* 0° *to the maximum polarising angle, a portion of light polarised in the plane of reflection. Above the polarising angle the part of the pencil polarised in the plane of reflection diminishes till* $\cos.\ (i + i') = (\cos.\ i - i')\ )^3$, *when it disappears, and the whole pencil has the character of common light. Above this last angle the pencil contains a quantity of light polarised perpendicular to the plane of reflection, which increases to a maximum and then diminishes to zero at* 90°.'

" Let us now examine the state of the pencil CS′ after only one refraction and one reflection. Resuming the formula $\tan.\ \varphi' = \dfrac{\cos.\ (i + i')}{(\cos.\ (i - i')\ )^2}$, it is evident that when $(\cos.\ (i - i')\ )^2 = \cos.\ (i + i')$, $\varphi' = 45°$, and the light restored to common light. This takes place in glass at an angle of 82° 44′. At all angles beneath this the pencil contains light polarised in the plane of reflection; but at all angles above it, the pencil contains light polarised perpendicular to the plane of reflection, the quantity increasing from 82° 44′ to its maximum, and returning to its minimum at 90°.

" Let us now apply the results of the preceding analysis to M. Arago's experiment. Suppose the angle of incidence to be 78° 7′, and let the light polarised by reflection at A (fig. 142) be = m, and that polarised by one reflection also = m. Then, since the pencil bs is common light, the polarised light in the whole reflected pencil AP, bs, is = m, whereas the light polarised by the two refractions is = $2m$; so that the experiment makes two quantities appear equal when the one is double that of the other. If the angle exceeds 78° 7′, the oppositely polarised light in the pencil bs will neutralise a portion of the polarised light in the pencil AP, and the ratio of the oppositely polarised rays which seem to be compensated in the experiment may be that of $3m$ or even $4m$ to 1.

" We may now obtain formulæ for computing the exact quantities of polarised light at any angle of incidence, either in the pencil CBS or bs.

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"The primitive ray RA being common light, AC will not be in that state, but will have its planes of polarisation turned round a quantity x by the refraction at A; so that $\cot. x = \cos. (i - i')$. Hence we must adopt for the measure of the light reflected at C the formula of Fresnel for polarised light whose plane of incidence forms an angle x with the plane of reflection. The intensity of AC being known from the formula for common light, we shall call it unity, then the intensity I of the two pencils polarised $-x$ and $+x$ to the plane of reflection will be

$$I = \frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} \cos.^2 x + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \sin.^2 x, \text{ and}$$

$$Q = I \left(1 - 2 \frac{\left(\frac{\cos. (i + i')}{(\cos. (i - i'))^2} \right)^2}{+ 1 \left(\frac{\cos. (i + i')}{(\cos. (i - i'))^2} \right)} \right)$$

"In like manner, if the intensity of CB $= 1$, we have

$$\tan. x = \frac{\cos. (i + i')}{(\cos. (i - i'))^2},$$

and the intensity I of the transmitted pencil bs

$$I = 1 - \frac{\sin.^2 (i - i')}{\sin.^2 (i + i')} \cos.^2 x + \frac{\tan.^2 (i - i')}{\tan.^2 (i + i')} \sin.^2 x \text{ and}$$

$$Q = \left(I\, 1 - 2 \frac{\left(\frac{(\cos. (i - i'))^3}{\cos. (i + i')} \right)^2}{1 + \left(\frac{(\cos. (i - i'))^3}{\cos. (i + i')} \right)^2} \right)$$

"The following table, computed from the formulæ in the preceding page, shows the state of the planes of polarisation of the three rays AC, CS, and bs.

Angle of Incidence on the First Surface.	Angle of Refraction at First Surface, and Angle of Incidence on Second Surface.	Inclination of Plane of Polarisation of AC, fig. 142.	Inclination of Plane of Polarisation of CS, fig. 142.	Inclination of Plane of Polarisation of bs, fig. 142.
0° 0′	0° 0′	45° 0′	45° 0′	45° 0′
32 0	20 33	45 34	32 20	32 51
40 0	25 10	45 58	24 12	24 56
45 0	27 55	46 17	17 49	18 38
56 30	33 30	47 22	0 0	0 0
67 0	37 34	48 57	18 20	20 50
70 0	38 30	49 33	23 34	27 6
75 0	39 46	50 45	32 22	37 48
78 37	40 29	51 49	38 10	44 59
79 0	40 33	51 56	38 49	45 46
80 0	40 42	52 16	40 27	47 46
83 0	41 5	53 21	44 39	53 40
86 30	41 23	54 47	50 58	60 13
90 0	41 58	56 29	56 29	66 19

Sect. VI.—*On the Polarisation of Light by Absorption and Dispersion.*

In the preceding section we have considered common light as consisting of two pencils of polarised light, having their planes of polarisation at right angles to each other. The very same results would take place if we considered a beam of light as consisting of two sets of polarised rays, all those of one set having their planes of polarisation in every possible direction, and of another set having their planes of polarisation at right angles to those of the former.[1] In this view of the subject, common light is polarised when it issues from the luminous body, and when we polarise it or decompose it by double refraction, or polarise it completely by reflection or refraction, we merely separate the one half of it polarised + from the half polarised —. This effect is analogous to the decomposition of white light into its colours. All the colours exist in the sun's light, and they are merely separated by prismatic refraction, or by interference, or by absorption.

Now common light may also be decomposed by dispersion and absorption; that is, if we can contrive any method of dispersing or absorbing *one of the two polarised pencils* of common light, we shall exhibit the other pencil in its state of natural polarisation.

Crystals in which this effect is produced are called singly polarising or singly refracting crystals. They were first observed and described by Sir David Brewster in the year 1812.[2] The first mineral in which he discovered this property was the agate, in which one of the pencils is dispersed into a nebulous mass of light, sometimes of the form of a crescent, so that the bright image was all polarised in one plane, like one of the pencils of Iceland spar. The mass of nebulous light, too, was always polarised in a plane perpendicular to that of the bright image.

The same author discovered a similar property in certain specimens of the carbonate of barytes, which exhibited several interesting phenomena,[3] in thick crystals of mica,[4] and in mother of pearl,[5] and very curiously in oil of mace,[6] and other substances. The same property he found in various artificial crystals, but particularly in nitre.

Another very beautiful example of polarised nebulous images was observed by the same author in an artificial kind of nacre already referred to, in which there are three nebulous polarised images, with a bright image enclosed in the middle one of the three nebulous images.[7]

A similar property was discovered in 1815 in the *tourmaline*, nearly about the same time, by M. Biot and M. Seebeck, the priority belonging to the former. This crystal has double refraction, like all other crystals of the same class; but when it is cut by planes passing through the axis of the crystal, and has a certain thickness (about the twenty-fifth of an inch, but which varies in different specimens), it transmits only one of the pencils formed by double refraction. The pencil polarised in the plane of the principal section is absorbed, or somehow or other lost, while the one depolarised at right angles to that section is transmitted. If we take two such plates of tourmaline, and place them with their axes parallel, the unabsorbed pencil will be freely transmitted through both; but if we begin to turn one of them round, the light will become fainter and fainter, and the luminous object will vanish entirely when the axes are at right angles to each other. By continuing to turn, the image again appears, reaches its maximum when the axes are parallel, and then vanishes when the axes are at right angles. The same phenomenon is exhibited by the *agate* in reference to its distinct image.

In all the singly refracting and polarising crystals above enumerated, the effects described arise from a certain degree of imperfection in the structure and combination of the elementary crystals, by which one of the polarised pencils is reflected or absorbed; but Sir David Brewster found that the same property may be communicated to any crystal, *merely by altering its superficial conformation.*

If we take a hexahedral prism of *nitrate of potash,* and

[1] Phil. Trans. 1815, p. 149. *Ibid.* 1830, p. 84.
[2] Treatise on New Philosophical Instruments, p. 329. See also Phil. Trans. 1813, p. 101. *Ibid.* 1814, p. 188.
[3] Edinburgh Transactions, vol. vii. p. 289.
[4] Phil. Trans. 1814, p. 225.
[5] Phil. Trans. 1814.
[6] *Ibid.* p. 27 and 38.
[7] Phil. Trans. 1836, p. 53.

Polarisation.

observe a luminous object through two of its inclined surfaces that have a good natural or artificial polish, we shall perceive two distinct and perfectly formed images. If we now roughen these two surfaces, and cement upon each of them a plate of glass by means of *balsam of capivi*, the character of the two images will be greatly changed. The image that has suffered the *greatest* refraction will be as *distinct* as before, but the other image will be either of a *faint reddish colour*, or wholly invisible, according to the degree of roughness induced upon the refracting surfaces. When *oil of cassia* is used instead of the balsam, the *least refracted image*, if it was visible before, will now be *completely extinguished.*

By substituting pure *alcohol*, or the *white of an egg*, instead of the balsam, the *least refracted image* will become *distinct*, and the *most refracted image* will be either a mass of *nebulous light*, or almost invisible.

In order to explain these phenomena, we must recollect that the index of refraction for the *ordinary* image of *nitre* is 1·511, and that of the *extraordinary* image 1·328. When the rough surface of the nitre is covered with balsam of capivi, which has nearly the same index of refraction as the ordinary image, the same effect is produced as if the rough surface had been polished for the ordinary rays. All the little pits or depressions in the rough surface being filled up with balsam, the ordinary rays suffer little or no refraction in penetrating the crystal, and therefore the image which they form will be as clear and distinct as in the first experiment. But since the index of refraction for the extraordinary image is much less than that of the balsam, the rays of which it is composed will not enter the crystal undisturbed, but will be scattered in the same manner as if its surface was rough, and had a refractive power corresponding to the difference between the index of refraction for the extraordinary ray, and the index of refraction for the balsam. When *water* or *alcohol* is substituted in room of the *balsam*, the effects now described are interchanged, the roughness being removed for the extraordinary rays by the application of a fluid of the same refractive density, while the rays that form the ordinary image are dispersed by the refractions which still exist at the rough surface of the crystal.

These effects will be better understood by supposing the crystal to consist of an extraordinary and an ordinary medium, arranged in alternate strata, or as water exists in wet hydrophanous opal. When the superficial polish of both these media is removed, the application of the *balsam* restores, as it were, the polish of the ordinary medium, without restoring that of the extraordinary medium; while the application of the *alcohol* restores the polish of the extraordinary medium without restoring that of the ordinary medium.

These results were repeatedly obtained with *calcareous spar, arragonite, nitre, carbonate of potash*, and other crystals;[1] and we have now before us a singly-polarising prism of *Iceland spar*, made nearly twenty years ago, which answers all the common purposes of a plate of tourmaline or a parcel of glass plates.

Sect. VII.—*On the Depolarisation of Light, and the Colours of thin Crystallized Plates in Polarised Light.*

The phenomena which we are about to describe are among the most splendid in optics. They were discovered by independent observation by M. Arago and Sir David Brewster; the priority of discovery belonging to M. Arago. The very same colours, indeed, as we shall presently see, had been observed by Huygens, Robison, Malus, and others, in Iceland spar; but they were not aware of their nature and origin.

There are *four* methods of exhibiting these colours, which may be used at pleasure, and each of which has its advantages.

1. If we take a plate of *agate* or *tourmaline*, or any other of the artificial singly-polarising crystals already described, and having cut it into two parts, each of which is at least equal to the diameter of the pupil of the eye, though this is not absolutely requisite, fix each of them above an aperture in a piece of card or brass, so that no light passes at their edges. Let them be now placed at the distance of an inch or more, the one near the eye being capable of turning round the axis of vision; and let this last be turned into such a position that the light of the sky, or that of a flame enlarged by a lens placed near it, is no longer able to penetrate the second singly-refracting plate.

If we now introduce between the two plates of tourmaline, for example, a plate, either thick or thin, of any doubly-refracting substance, we shall observe very curious effects. If the plate is *thick*, such as one of sulphate of lime, the 30th of an inch and upwards, we shall find that the insertion of the plate has *revived*, as it were, the light which refused to pass through the second plate, and this light will be white. If we turn the sulphate of lime round, we shall find *four positions* 90° from each other, in which the revived light is a maximum; and other four bisecting these, and also 90° from each other, in which the light entirely vanishes, as before the sulphate of lime had been introduced.

This property of reviving the light has been called the *depolarisation of light*, because the sulphate of lime deprives the rays polarised by the first plate, of that kind of polarisation which prevented them from penetrating the second plate.

But if the plate is thin, between the fiftieth and the seventy-fifth of an inch, we shall have precisely the same phenomena, with this difference only, that the restored light is brilliantly coloured. The colours vary in intensity, like the white light, disappearing in the positions 0°, 90°, 180°, and 270°, and reaching their maximum at 45°, 135°, 225°, and 315°. If we now turn the plate of tourmaline next the eye round 90°, so that the axis of the two plates are parallel, and the pencil polarised by the first freely transmitted by the second, and if we then introduce the same plate of sulphate of lime as before, we shall now find that in the *four* positions of it, viz. 0°, 90°, 180°, and 270°, where no light or colours were formerly, nothing but white light is visible; but that at the positions 45°, 135°, 225°, and 315°, where the maxima of light and colour took place, we have the maxima of a colour *complementary* to that formerly seen, the intensity of this colour gradually increasing from nothing at 0°, reaching its maximum at 45°, again diminishing to 90°, and so on with the other quadrants. These colours are called the *colours of crystallized plates, or the colours of polarised light.*

In the preceding experiment with plates of tourmaline, we see only one of the two complementary colours, while the position of the tourmaline remains the same. The disadvantage of using the tourmalines is, that, from their brown colour, the brilliancy of the polarised colours is greatly injured; and the tourmalines therefore cannot be employed, either when we wish to have the most brilliant representations of the phenomena, or when it is necessary to study the exact tints which are developed.

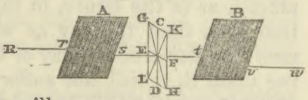
But if we use the plates of *agate* or of roughened Ice-

[1] Phil. Trans. 1819, p. 146

land spar in the same manner, we shall not only have identically the same phenomena of colour in the bright and distinct image formed by the agate with a purer light; but we shall have the additional phenomenon of this bright coloured image placed in the middle of a *nebula* or haze of the *complementary* colour, so that we here see both the colours at the same time, and without any of the superadded brown colour imparted by the tourmaline. If the colour of the distinct image is *green*, it will be encircled by a haze of *red* light; if it is *blue*, with a haze of *orange* light; and so on.[1]

2. The *second* method consists in placing the film of *sulphate of lime* GKHL between two bundles of glass plates A and B, which polarise the light by *refraction*, as shown in the annexed figure. A ray R*r* emerges from A, polarised as at *st*, and will freely penetrate the second bundle B, and emerge, as shown at *vw*, when the planes of refraction of A and B are parallel, as in the figure; but not a ray of *st* will emerge at *v* when the planes of refraction are perpendicular to each other. When we interpose, therefore, the sulphate of lime GKHL, it will exhibit *identically* the same phenomena as between the tourmaline plates, the bundle A corresponding to the fixed plate, and B to the moveable one, and the planes of refraction corresponding to the axes of the tourmaline. If we suppose the bundles A and B to be placed with their planes of refraction perpendicular to each other, then the position of the plate of sulphate of lime, in which no colour appears, is, when its axis of double refraction CD is its principal axis (viz. the line bisecting the resultant axis) if it is biaxal, *parallel* or *perpendicular* to the planes of refraction. When CD, therefore, or EF (perpendicular to it), is in the plane of refraction of A, or *the plane of primitive polarisation*, as it is called, not a ray of coloured light reaches the eye at *v*, and hence these have been called the *neutral axes* of the plate of sulphate of lime, because they produce no change upon the ray *st*. On the other hand, when the lines GH, KL, perpendicular to each other, and inclined forty-five degrees to the *neutral axes*, are in the plane of primitive polarisation, the coloured light depolarised is a maximum, and hence they have been called the *depolarising axes* of the plate GKHL, names which will be found very convenient in the description of phenomena.

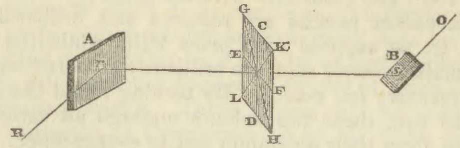
Fig. 143.



It is an interesting fact, which was discovered by Sir David Brewster, that nature actually presents us, in the case of certain crystals of *nitre*, with the whole of the apparatus in the space of half an inch. One part of the crystal has its laminæ inclined like the bundle A, while another part has them lying in a rectangular direction like B; so that such a crystal, by merely looking through it when the opposite faces are either polished by art or by a cement, exhibits its own coloured rings. Sir John Herschel subsequently observed the same fact in carbonate of potash, and proposes to call such crystals *idiocyclophanous*, or *those which show their own rings*.

3. The *third* method is shown in the annexed figure, where A is a plate of black glass (or a bundle of 8 or 12 plates of thin transparent glass, for the purpose of increasing the light), which polarises in a horizontal plane a ray R*r*, incident at an angle of 56°, reflecting it polarised in the direction *rs*, where it is received upon a second plate of black glass B at the same angle of 56°, so

Fig. 144.

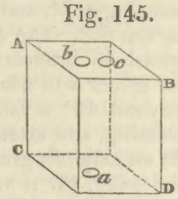


as to reflect it to the eye at O. If the plane of reflection from B is vertical, so as to be perpendicular to that from A, not a ray of the pencil R*r* will be reflected, but the eye at O will perceive a large black spot on the part of the sky or other luminous surface from which the ray R*r* proceeds.[2] The plate or plates at A are called the *polarising plates*, and that at B the *analysing plate*.

The plate of sulphate of lime is then placed at GKHL, anywhere between the plates, and it will exhibit the very same phenomena as between the tourmalines and the bundles of plates, though with more brilliancy and distinctness, as there is no brown colour to disturb the tints, and no haziness, as happens with the second bundle B of plates of glass. In this method the planes of reflection perform the same part as the axis of tourmaline and the planes of refraction in the other cases.

4. The *last* method which we shall mention, is to employ rhombs of Iceland spar, both for polarising and analysing the light. If the Iceland spar is converted into two of Nicol's prisms, then each prism performs exactly the same part as the tourmaline and the reflectors, exhibiting only one of the complementary colours. This ingenious contrivance, which derives its name from its inventor, William Nicol, Esq. of Edinburgh, consists of two pieces of calcareous spar cemented together so as to transmit only one of the polarised pencils; but the difficulty and expense of constructing it well, and the risk of a change in the state of the cement which unites the two parts, render it desirable to have a simple, a cheap, and a durable substitute for it. The polariser and analyser used by Sir David Brewster in many of his experiments in elliptical polarisation, and in the action of crystallized surfaces, was a *single* rhomb of calcareous spar, having thin plates of colourless glass cemented to its natural surfaces by Canada balsam, which, while it removes any imperfection of surface, protects the surfaces from any accidental injury, or from the deterioration of the polish arising from frequently cleaning them. This rhomb, shown at ABCD, may be of any thickness suited to the diameter of the pencil of light which we wish to have. By a rhomb one inch thick we can obtain a pencil of light 0·115 of an inch in diameter; by placing an aperture of that diameter at *a* on the lower side CD, we obtain two pencils *b*, *c*, polarised in opposite planes, and just touching each other. If we wish to use only one pencil, we can conceal *b* or *c* with a wafer, and use the other; but for the purpose of our present experiment they may both be left clear. If we now construct an exactly similar, or a larger rhomb, without any aperture upon it, and place the two as we did the tourmaline plates, or in any of the positions shown in fig. 130, we shall see only *two* images, the other two being evanescent. Let the plate of sulphate of lime be now interposed as formerly, and we shall find, that when its principal axis CD forms angles of 0°, 90°, 180°, and 270° with the plane of the principal section of the rhombs, no

Fig. 145.



Fourth method.

[1] We would recommend it to Mr Watkins to prepare this apparatus with the same ingenuity with which he has done the other apparatus for exhibiting the other phenomena of polarised light.

[2] The appearance of this black spot shows that the two reflectors are properly adjusted, so as to save all the trouble of attending to the angles at which the rays are incident on the two reflectors A and B.

Polarisation.

light is depolarised; but that when the axis forms angles of 45°, 135°, 225°, and 315° with the principal section, the *two* evanescent pencils are restored and brilliantly coloured, let us suppose with *green* light, while the other two pencils formerly seen are brilliantly coloured with the complementary *red* colour. By turning round the rhomb next the eye, these two colours undergo all varieties of intensity, from their maximum tint to evanescence.

If we now enlarge the aperture *a*, fig. 145, in the first rhomb, so that the two images *b*, *c*, in place of being in contact, overlap each other, we shall have the parts that do not overlap exhibiting the two complementary colours as before, while the parts that do overlap form *perfectly white light;* thus proving that the two colours are exactly complementary to each other. Any of the images *b*, *c* may be enlarged, if necessary, by a convex lens placed before them, or by other means.

In order to obtain a large pencil of polarised light *b* or *c*, we must make the rhomb very thick; but there is another way in which we may obtain the same effect in thin rhombs. There are particular specimens of the spar which are interrupted with veins, and which will be described in a separate section. If we obtain one of these in which the vein has a certain thickness, it will produce polarised images on each side of *b* and *c*, and these images will be perfectly *white*. We may therefore use a much larger aperture *a*, and obtain a very effective apparatus. This, however, will be better understood afterwards.

When the *veins* above mentioned are *thin*, these lateral images are beautifully coloured, the colours being portions of the coloured rings produced by the thin vein, the prism in front of the vein polarising the light, and the prism behind it analysing it.

These different methods of exhibiting the colours of crystalline plates may be varied, if we use a plate of glass as the polariser, and a tourmaline for the analyser; or, in short, we may use one half of each apparatus with one half of the other. When we wish to have a large surface of polarised light, the best and readiest is a large surface covered with black varnish.

In the preceding observations, with the *four* different kinds of apparatus, we have supposed the polariser and analyser to be fixed, either with their similar planes parallel or perpendicular to each other, and the plate of sulphate of lime to be moved round its axis. Let us suppose, however, that the sulphate of lime is *fixed* in the position where its colour, *bright red*, for example, is a maximum; that is, where any of the depolarising axes GH or KL, fig. 144, is parallel or perpendicular to the plane R*rs* of primitive polarisation. In this position of GH, let the analysing plate B be made to revolve round the ray *rs*, its motion commencing at 0°, and always keeping the same inclination to *rs*, viz. 56°. The *bright red* visible at 0° will gradually diminish in intensity as B moves from 0° to 45°, when the *red* colour will wholly vanish, and the black spot be seen. Beyond 45° a faint *green* tint will appear, gradually increasing, and attaining its maximum of brightness at 90°. At an azimuth greater than 90°, the green becomes paler and paler, till it vanishes wholly at 135°. Here the *red* again begins, and reaches its maximum brightness at 180°. Similar changes take place while the plate B moves from 180° to its original position at 360° or 0°. Hence it appears, that when the sulphate of lime alone revolves, only one of the complementary colours is visible, whereas, when the plate B only revolves, both the complementary colours are visible during each half of its revolution.

When these experiments are repeated with plates of sulphate of lime, or any other mineral having different thicknesses, different colours will be produced, varying with the thickness; and in every case the two colours which are produced, either when we use the two polarising rhombs, or cause the reflector B to revolve, are always *complementary* to each other, or together make white light.

If we remove the plate B, and look through the sulphate of lime, we shall find that the light which it transmits is always white, whatever be the position of the sulphate of lime, whatever be the inclination which the ray R*r* forms with the polariser A, and whatever be the condition of the polariser itself. The decomposition of the white light, therefore, or its separation into two complementary colours, must be effected by reflection from the plate B. Now sulphate of lime is a doubly refracting crystal, giving two oppositely polarised images, lying above one another, and one of its neutral axes CD is the section of a plane passing through its principal axis of double refraction, while EF is the section of a plane perpendicular to that section. Let any of these planes, suppose EF, be placed, as in the figure, in the plane of primitive polarisation R*rs*, then the ray *rs* will not be doubled, but will pass into the ordinary ray of the sulphate of lime, and falling upon B, it will not suffer reflection. The very same will happen if CD is brought into the plane of primitive polarisation, so that in these two positions none of the light transmitted through the sulphate of lime will suffer reflection at B, and reach the eye at O. In all other positions, however, of the sulphate of lime, it forms *two* images or pencils of different intensities; and when either of the depolarising axes GH or KL is in the plane of primitive polarisation R*rs*, these two images or pencils will be of equal intensity, and polarised in opposite planes. Now, one of *these* images is *red*, and the other *green*, a fact which will be afterwards explained; and as the *red* is polarised in the plane of primitive polarisation, it will not suffer reflection from B; while the *green*, being polarised in the plane of reflection from B, will be reflected to the eye at O, and is therefore seen alone. From the same cause, when B is turned round 90°, the *green* will not suffer reflection from it; while the red will suffer reflection, and be seen by the eye at O. The plate B has therefore analysed the compound beam of *red* and *green* light by reflecting one and transmitting the other colour.

Now, if the sulphate of lime had been thicker than the fiftieth of an inch, the two pencils would have been both white; and when the plate was moved round, we should have had a white pencil reflected from B, and undergoing the very same changes that the coloured one did. Hence we see the cause of the *depolarisation of light*, both when the depolarising plate is thick and thin.

In the preceding experiments, the sulphate of lime has been supposed to be so thin as to give a *red* and a *green* tint; but if the plate is only 0·00046 of an English inch thick, it will depolarise no light at all, either coloured or uncoloured, and the black spot will be seen in every position of the sulphate of lime. If the thickness of the plate is 0·00124 of an inch, the light depolarised will be the *white*, the first order of Newton's scale, whose complementary colour is a deep *violet;* and if the plate is 0·01818 of an inch, or upwards, it will also polarise white light, composed of all the colours of the spectrum. When the plates of the mineral have an intermediate thickness between 0·00124 and 0·01818, they will give, at successive thicknesses, all the intermediate colours in Newton's table, between the white of the first order, and the white compounded of all the colours. The colours from the plate B will be those in col. 2 of Newton's table, while the colours seen in turning round the plate B will be the complementary ones in col. 3 of the same table, the one corresponding to the *reflected* and the other to the *transmitted* tints of thin plates.

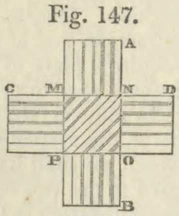
By a variety of accurate experiments, M. Biot pointed out the connection between the colours of polarised light and of thin plates; and in the case of sulphate of lime, the films of which he measured with an ingenious instrument invented by M. Cauchoix, called the spherometer, he has proved that the thicknesses which produce the different colours in Newton's table are proportional to the value of the tints in the last column of Newton's table for glass; this substance having nearly the same refractive power as sulphate of lime. If we wish, for example, to know the thickness of sulphate of lime which will give the *red* of the first order of colours, the number in the last column opposite red is $5\frac{4}{5}$ths; then, since the *white* of the *first* order is produced by a plate 0·00124 of an inch thick, the number opposite which is $3\frac{2}{5}$ths, we say, as $3\frac{2}{5}$ths is to $5\frac{4}{5}$ths, so is 0·00124 to 0·00211, which is the thickness at which sulphate of lime depolarises the *red* of the first order. By reversing this rule we can determine the colour which will be depolarised at any given thickness. This law of the colours is by no means general, and we shall presently see that the colours of polarised light bear frequently no relation whatever to those of thin plates.

The above phenomena may be beautifully exhibited to the eye by combining pieces of sulphate of lime into a painted Gothic window, so that when the window is exposed to common or to polarised light it appears perfectly colourless, but when seen by reflection, it will exhibit all the splendid colours of the separate films. Though this experiment is well suited for exhibition, yet the following one, which was also made by Sir David Brewster, is more instructive. Selecting an uniform plate of sulphate of lime, about the twenty-fifth of an inch thick, he ground down,[1] with the powder of schistus, one of its faces, so as to make it a sort of wedge, in which the thickness varies from the twenty-fifth of an inch down to the thinnest edge that could be made. The plate was then placed in water, which acted upon it slowly, making its edge thinner, and giving a slight polish to its surface. When this film is placed at GH, in fig. 144, its figure will be seen covered with coloured fringes, as in fig. 146, parallel to its edges. At its thinnest edge the colours of the first order will commence from *black*, and gradually increasing, as in Newton's table, till, at the thick edge AD, we have the sixth or seventh, or higher orders of colours. Here we see at once how all the different tints and different orders are connected with the different thicknesses of the plate.

Fig. 146.

If we now cut this plate into two equal parts AB, CD, and cross them as in the figure, a *new set of fringes* will appear, parallel to a line joining the points where the two thinnest and the two thickest edges intersect, that is, parallel to NP, one of the diagonals of the intersectional square MNOP. The line NP will be black, and from NP to M and N the fringes will be exactly the same as those from the thin to the thick edge of the plate.

Fig. 147.



If the plates *ab, cd* have their axes at right angles to each other, there will be only one set of fringes, beginning at the angle where the two tints are minimum.

If we grind one side of the plate spherical, so that the thickness shall vary like the plate of air between a convex and a plane surface, then, by combining a plate of this kind with a prismatic plate, or by combining two similar plates, and by varying their maximum thicknesses, their breadths, &c. we shall produce, by their parallel or rectangular combination, intersectional fringes of figures of great variety and extreme beauty. These figures will be analogous, *mutatis mutandis*, to those observed by Mr Knox, and the far more splendid exhibitions produced by crossing plates of glass in the manner described in a subsequent chapter.

Polarisation.

If we grind *concave* surfaces on one of the faces of the crystalline plate, we shall have circular rings, equidistant if the concavity is conical, but resembling those of thin plates if it is spherical. These plates may also be combined with those which give circular and rectilineal fringes, and very fine effects produced by the combination.[2] Still more remarkable effects may be produced by turning beautiful patterns upon the sulphate of zinc, or etching them either by the action of pure *water*, or water slightly acidified. Lines of equal depths will be all equally coloured, and the slightest differences in depth, which can be easily regulated by a fine turning-lathe, will produce a great variety of different colours. Coloured figures and landscapes may be executed by scraping away the surface to the thickness necessary to produce the requisite tints. A cipher, too, might be executed upon a mineral; and if we cover the surface upon which it is formed with a fluid of the same refractive power, it will be absolutely illegible by common light, but may be distinctly deciphered when placed between the polarising and analysing plates.

A sheet of ice irregularly frozen, and held in the position just mentioned, exhibits the colours of crystallized plates in a splendid manner; but if in a severe winter, when ice can be handled without melting, we take an uniform plate, and dissolve a pattern upon it by heat, which may be applied in many ways, so as to affect only the parts to be made thinner, we shall observe a phenomenon than which nothing can be more splendid.

Sect. VIII.—*On the System of Rings produced by Uniaxal Crystals.*

In the preceding experiments the crystallized plate is held at such a distance from the polarising plate that its surface could be distinctly seen by the eye; and it was from observations made in this manner that M. Biot deduced his empirical formulæ for expressing the variation of the tint, as depending on the thickness of the crystallized plate, and on the square of the sine of the inclination of the refracted ray to the axis of the crystal.

Rings in uniaxal crystals.

From this mode of observation M. Biot concluded, that *arragonite, topaz, sulphate of lime, felspar, sulphate of barytes, and sulphate of strontian*, were all crystals with one axis of polarisation and double refraction. In 1813, however, Sir David Brewster was led to an entirely different mode of observation. He brought the crystal or plate as close to his eye as possible, and by using a large polarising plate, such as a black japanned tray, he was able to see, *at the same instant*, the colours produced at various angles of inclination, in place of determining the loci of these colours, as was done in the old way, by a great number of insulated observations.

When, for example, he looked through the *ruby*, the *emerald, topaz, ice, nitre*, and other bodies, he observed the most beautiful system of rings when the polarised light

[1] The plate may be cemented by one of its faces to a piece of plate-glass, which will protect it from breaking, and after it is finished and bisected, each half should be enclosed between two glass plates.

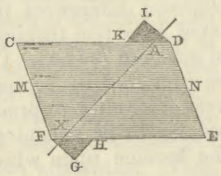
[2] We would recommend to the practical optician the construction of such plates as a matter of trade.

Polarisation.

passed along the axis of double refraction of these bodies. The rings in crystals with one axis are essentially different from those with two axes.

The *uniaxal system of rings* is represented in Plate CCCLXXXIII. fig. 29, 30. I discovered them in all the doubly refracting crystals with one axis, already mentioned, excepting in Iceland spar, in which they were first observed by Dr Wollaston, and independently by M. Biot and Dr Seebeck. This system of rings is seen along the axis of double refraction; and it has been customary to cut faces upon the obtuse angles of the rhomb of calcareous spar perpendicular to the axis, in order to see them. Sir David Brewster, however, employed the simple method shown in the annexed figure, which does not require the aid of the lapidary. Let CDEF be the principal section of a rhomb of Iceland spar; cement upon CD and EF two small prisms DLK, FGH, having the angles LDK, GFH about 45°. each; and let this rhomb be placed between the polarising and analysing plates, so that the polarised ray *rs* passes perpendicularly through the faces LD, FG. The rhomb must be held as close as possible to the reflector B, which need not be larger than the pupil of the eye. When the black spot is seen on the reflector B, in the apparatus as adjusted, then, when the rhomb is interposed, the observer, with his eye close to the plate B, and looking, as it were, through the reflected image of the rhomb, will see the beautiful system of rings shown in fig. 29, Plate CCCLXXXIII., intersected by a black rectangular cross AB, CD, the arms of which are parallel and perpendicular to the plane of primitive polarisation. The colours of the rings, of which seven or eight may be readily seen, are almost exactly the same as those of the reflected rings in thin plates, as seen in Newton's table or scale of colours.

Fig. 148.



If we turn the rhomb round its axis, the rings will suffer no change, the four arms of the black cross revolving round the circumference of the rings, or rather these four arms remain fixed, and the rings revolve with the rhomb.

If the rhomb is now fixed so that the rings are distinctly visible, and if we cause the plate to revolve from zero or 0°, then the rings will change into the form shown in fig. 30, Plate CCCLXXXIII., in which the black cross is broken up; and at 45° the rings will appear as in fig. 31, which is the *complementary system*, with a white centre exactly similar to the system seen by transmission in thin plates. These two systems of rings superposed or placed one above the other, would produce uniform white light, without any trace of rings. By continuing to turn B, the *primary system*, fig. 29, will re-appear at 90°, 180°, and 270°; and the *secondary system*, fig. 31, at 45°, 135°, 225°, and 315°; while the *intermediate system*, fig. 30, will be seen at intermediate azimuths.

It is very interesting to trace the passage of the *primary* into the *secondary* system. When B begins to turn, the arms of the black cross widen and become less black, and within them we can see segments of the *complementary* rings, whose dark intervals correspond to the bright ones of the primary rings, and *vice versa*. As B advances, the rings of the primary set grow less, and more dilute, while the others grow larger and brighter, till, at 45°, the *secondary* set is complete. When the light previous to polarisation has passed through ground glass, the diluted primary rings appear of a gray-white colour, and as if they were nearer the eye than the rest.

If, in place of the plate B, we use a polarising rhomb or an achromatised prism of Iceland spar, and look through it along the axis of the other rhomb, then, when the plane of its principal section is parallel or perpendicular to the plane of primitive polarisation, we shall see in one of its two images the *primary* system of rings, and in another the *secondary* system; and in intermediate positions we shall see the intermediate system, the one constantly passing into the other.

When all these experiments are repeated in homogeneous light, the system of rings will be *smallest* in *violet*, and *largest* in *red light*, and of intermediate sizes in intermediate colours.

If we divide the rhomb of spar, fig. 148, into two parts by the line MN, and examine the rings through each separately, we shall find that the rings produced by each part are *larger* than those produced by the whole, the thinnest piece producing the largest rings. Hence two rhombs united will give a system of rings corresponding to those produced by one rhomb of the same magnitude.

The systems, if formed by *zircon*, *ice*, and positive doubly-refracting crystals, are exactly the same as the preceding. But if we unite a positive system with an equal negative system, they will destroy each other; and if the two systems are unequal, we shall have a system equal to the difference of their effects. These experiments of combining systems of positive and negative rings, though rather troublesome, are extremely interesting. When such systems are combined, and the space between the crystals that form them left open, a series of splendid changes are induced upon the resulting system, by placing one or more crystallized films in one or more azimuths between them; but we shall have occasion to return to this subject in the section on the multiplication of images by Iceland spar.

In examining the phenomena of the primary rings, it is obvious that there is no polarisation, as there is no double refraction along the axis of the crystal. The tints polarised increase with the double refraction, that is, with the inclination of the polarised ray to the axis of double refraction; and their numerical value, as given in Newton's scale, increases with the square of the sine of that inclination. At any given inclination to the axis the tint increases with the thickness through which the polarised ray passes, so that when we have determined the tint at any given inclination and thickness, it is easy to find it for another inclination and thickness.

In crystals with one axis of double refraction, the lines of equal double refraction are circles when the thickness is equal, as in a sphere; in like manner, the lines of *equal tint*, or the *isochromatic lines*, are circles, the tints being a maximum in the equator, where the inclination to the axis is 90°. In crystals with great double refraction the same tint at the same inclination to the axis is produced at a much less thickness than in crystals with feeble double refraction. Quartz, for example, has a very feeble double refraction, and at the same inclination to the axis it would require a plate of quartz 115 times as thick as a plate of Iceland spar to produce the same tint in Newton's scale.

In some crystals with one axis, such as quartz, amethyst, beryl, the system of rings is disturbed by secondary causes, which we shall have occasion to refer to more fully in regard to the two first crystals. In other crystals imperfect crystallization is the general cause of these irregularities.

In Iceland spar, zircon, ice, tourmaline, and various other minerals, the tints of the rings are very nearly those of Newton's scale; but there are other crystals, such as apophyllite, in which Sir David Brewster and Sir John Herschel discovered remarkable deviations, which will be described in a subsequent section.

The intensity of the polarising force, or the value of the tint polarised at a given thickness, has been calculated by different persons for different crystals. The following have been given by Sir John Herschel for uniaxal crystals.

	Numerical Value of the highest Tint.	Thicknesses that produce the same Tint.
Iceland spar	35801	0·000028
Hydrate of strontia	1246	0·000802
Tourmaline	851	0·001175
Hyposulphate of lime	470	0·002129
Quartz	312	0·003024
Apophyllite, first variety	109	0·009150
Camphor	101	0·009856
Vesuvian	41	0·024170
Apophyllite, second variety	33	0·030374
third variety	3	0·366620

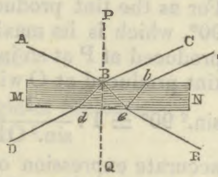
These measures are calculated for the *yellow* rays.

Sect. IX.—*On the System of Rings produced by Biaxal Crystals.*

The biaxal system of rings was discovered by Sir David Brewster, while he was looking along one of the axes of *topaz* when the crystal happened to reflect the light of a part of the sky which was partially polarised, so that they were seen without the aid either of a polarising or an analysing plate.

Upon examining other minerals, he discovered that the possession of two systems of rings was the characteristic of by far the greater number of crystallized bodies. In some of the crystals, such as *topaz*, the lines along which each system of rings is seen are so much inclined to each other, that we cannot see the two systems at once; whereas in others, where the inclination of the lines is small, both the systems may be distinctly seen at the same time. This will be understood, in the case of topaz, from fig. 149, where MN is a plate of topaz with parallel faces of cleavage perpendicular to PQ, the principal axis of double refraction. If we expose this plate to polarised light, so that the polarised ray passes along the line ABeE (the plane of incidence being in one of the two neutral axes of the plate); and if the eye at A receives this ray *without* using the *analysing plate*, it will see in the direction of that ray a system of oval rings of extreme beauty, like that shown in Plate CCCLXXXIII. fig. 32. When the polarised light is transmitted along the line CB*d*D, equally inclined to the perpendicular PQ, it will see a similar system. The lines BD, B*e* are therefore the resultant axes of topaz, along which the double refraction vanishes. The angle ABC is about 121° 16′, but the inclination of the refracted rays or of the resultant axes is only 65°. Similar rings are seen by transmission in the direction D*d*, E*e*, but only *when the analysing plate* is used.

Fig. 149.



If we now receive the reflected ray upon the analysing plate at 0°, the system of rings will appear as in fig. 33, Plate CCCLXXXIII., which differs from fig. 32 only in the parts near the major axis. The colours are the same, but the central spots are much smaller, and the mass of darkness with which they are surrounded encroaches considerably upon the blue part of the first ring. The same system will be seen at 90°, 180°, 227°; but upon turning round the analysing plate, we shall see, at 45°, 135°, 225°, and 315°, a third set, shown in fig. 34, which is comparatively faint in its colour, but distinguished by its peculiarities. In its general structure it resembles the set in fig. 32, but in the middle of each central spot there is a darker spot, composed of blue and red chiefly, with a little green above the blue, and every ring is divided into two rings, each of which has the same colours as the original ring. This division of the rings occupies only a part of the semicircumference of each, and is not seen beyond the third ring. When the analysing plate begins to move from 0°, 70°, &c. where fig. 33 is seen, towards 45°, 135°, &c. two blue spots, and the division of the rings, begin to appear at A and A in all the rings, and in the two central spots, and move along each till they reach B at 45°, 135°, &c. Continuing to turn the analyser, the spots and divisions move onward from B to C in all the rings, &c., and disappear at C at 90°, 180°, &c. This curious system of rings is obviously the first set in fig. 32, seen at the same time with their complementary rings, and is a very rare phenomenon.

Polarisation.

Rings in nitre.

The biaxal system of rings is best seen in *nitre* or *saltpetre*, in which the inclination of the resultant axes is only about 5°, or forming an angle of $2\frac{1}{2}$ with the axis of the six-sided prism. When a plate of nitre, about the sixth or eighth of an inch thick, is placed before a small analysing plate, and very close to it, and the eye also held as close to the analysing plate as possible, we shall see the beautiful biaxal system of rings discovered by Sir David Brewster, and shown in Plate CCCLXXXIII. fig. 35, where the plane passing through the two axes of nitre is parallel or perpendicular to the plane of primitive polarisation. At angles inclined 45° to these planes, the rings assume the form shown in fig. 36. In passing from the one of these states to the other, the rings assume the forms shown in figs. 37 and 38. The colours begin at the centres A and B of each system; but at a certain distance, varying with the thickness of the plate, the rings, in place of returning and encircling each pole, encircle the two poles, as an ellipse does its foci. When the thickness of the plate is very small, the rings enlarge, and the fifth ring will surround both poles. At a less thickness the fourth, and so on, till at a very small thickness the first ring, will surround both poles, and the system then resembles much the uniaxal system of rings. If the plate of nitre is very thick, the rings diminish in size. These colours deviate more and more from those of Newton's scale, and the tints do not begin at the poles A and B, but at virtual poles in their vicinity. The colours of the rings within the two poles are *red*, and beyond them *blue*, and the great body of the rings is pink and green. The rings have been called *isochromatic lines*, or *lines of equal tint*; and the axes passing through the poles A, B, *optical axes*, or *axes of compensation*, or *resultant axes*.

We have already given a long list of the various minerals and crystals which exhibit the biaxal system of rings, and also the position of the line which bisects the angular distance between the resultant axes, which is the *principal axis* of the crystal.

The following table, showing the inclination of the resultant axes in different crystals, was drawn up from the observations of Sir David Brewster. Several observations by other observers have been added.

Names of Minerals.	Character of Principal Axis.	Inclination of Resultant Axis.	
Glauberite	Negative	2° or 3°	0′
Sulphate of nickel, certain specimens	Positive	3	0
Carbonate of strontites	Negative	6	56
——— barytes	Ditto		...
Nitrate of potash	Ditto	5	20
Mica, certain specimens	Ditto	6	0
Talc	Ditto	7	24
Carbonate of lead	Ditto	10	35
Sulphato-carbonate of lead	Ditto	10	30
Mother-of-pearl	Ditto	11	28
Hydrate of barytes	Ditto	13	18
Mica, certain specimens, about	Ditto	14	0
Arragonite	Ditto	18	18

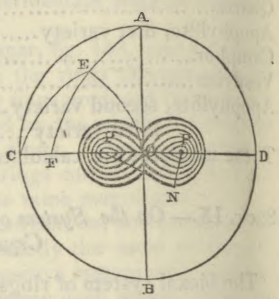
Polarisation.

Names of Minerals.	Character of Principal Axis.	Inclination of Resultant Axis.
Pyroxene (Miller)		19° 30′
Prussiate of potash, certain specimens	Positive	19 34
Cymophane	Ditto	27 51
Borax	Ditto	28 42
Anhydrite[1]	Ditto	28 7
Mica (Biot)		30 to 37 0
Apophyllite, *biaxal*	Negative	35 8
Sulphate of magnesia	Ditto	37 24
——— barytes	Positive	37 42
Spermaceti, about	Ditto	37 40
Tincal, or native borax	Negative	38 48
Nitrate of zinc, estimated at about		40 0
Stilbite	Positive	41 42
Sulphate of nickel	Ditto	42 4
Tartrate of ammonia (Miller)	Negative	42 20
——— (Herschel)		45 0
Carbonate of ammonia	Negative	43 24
Anhydrite (Biot)		44 41
——— (Herschel)		43 48
Mica	Negative	45 0
Lepidolite	Ditto	45 0
Benzoate of ammonia	Positive	45 8
Sulphate of zinc	Negative	44 28
——— magnesia and soda	Positive	46 49
Hopeite	Negative	48 0
Brazilian topaz	Positive	49 50
Sulphate of ammonia	Ditto	49 or 42 0
Sugar	Negative	50 0
Sulphate of strontites	Positive	50 0
Murio-sulphate of magnesia and iron	Negative	51 16
Sulphate of ammonia and magnesia	Positive	51 22
Heulandite (Herschel)		54 17
Phosphate of soda	Negative	55 20
Comptonite	Positive	56 6
Felspar	Negative	58 30
Sulphate of lime	Positive	60 0
Oxynitrate of silver	Ditto	62 16
Dichroite or iolite	Negative	60 50
Topaz (Aberdeenshire)	Positive	65 0
Sulphate of potash	Ditto	67 0
Carbonate of soda	Negative	70 1
Acetate of lead	Ditto	70 25
Citric acid	Positive	70 29
Tartrate of potash	Negative	71 20
Benzoic acid (Miller)	Ditto	75 0
Tartaric acid	Ditto	79 0
Sulphate of oxide of iron and ammonia (Miller)		79 0
Tartrate of potash and soda	Positive	80 0
Carbonate of potash		80 30
Kyanite	Positive	81 48
Hyper-oxymuriate of potash		82 0
Muriate of copper		84 30
Epidote, about		84 19
Peridot		87 56
Crystallized Cheltenham salts		88 14
Hyposulphate of soda (Marx)		89 20
Succinic acid, estimated at about		90 0
Sulphate of iron, about		90 0

Many of the measures in the preceding table were taken with much care; but some of them were only estimated, and others will admit of correction by the use of better specimens than the author was able to procure.

In order to explain the biaxal system of rings, and to discover the law of the tints by which every point of the complex system of rings can be calculated, Sir David Brewster considered the *optic or resultant axes* P, P′ as produced by two or more rectangular axes, the principal one passing through O, and the other two at AB and CD. We shall suppose, however, the most simple case, where the axes are only *two*, viz. that at O, and another either coinciding with AB or CD, perpendicular to O. Now, if O is a *negative* axis, AB must also be *negative;* but if we take CD for the other axis, it must be *positive;* for as the axis CD compensates the *negative* axis O at P, acting in the same plane, it must be a *positive* axis, for a negative axis would have united its effect with that of O. For a similar reason, the axis at AB must be *negative*, in order to compensate the *negative* axis O in a plane at right angles to it.

Fig. 150.



Supposing, then, O and AB to be two *negative* axes, as in *mica*, let it be required to determine the system of rings which they will produce, or the *tint* at any point F. Now we may either assume the relative intensities of these axes, or, what is better, the angle formed by the two poles P, P, where the actions of the two axes are compensated, as this angle can be readily measured in any crystal. As the action of the axis AB (or the tint which it produces) at P is destroyed or compensated by the action of the axis O, or the tint which it produces, and as the tint is proportional to the square of the sine of the angle which the ray makes with the axis, it is evident that the intensity of the axis at O must be to the intensity of AB, as 1 to $\frac{1}{\sin.^2 OP}$. For as the tint produced at P by AB at an inclination of 90°, which is its maximum tint, is equal to the tint of O produced at P at an inclination equal to OP, the *maximum* tint produced at O will be found thus: $\sin.^2 OP : \text{rad.}^2$ or $\sin.^2 90° = 1 : \frac{1}{\sin.^2 OP}$. We have therefore obtained an accurate expression of the relative intensities of the two negative axes O and AB.

If we had supposed the rings to be produced by a *negative* axis O and a *positive* one CD (which would equally account for the phenomena), then the intensity of O will be to that of CD as $\cos.^2 OP$ is to $\sin.^2 OP$.

From a great number of observations made at all inclinations to the resultant axes, and from accurate measurement of the projected rings, Sir David Brewster found that all the phenomena of the rings, with all their varieties of form and curvature, were represented by the following law.

The tint produced at any point of the sphere, by the joint action of two axes, is equal to the diagonal of a parallelogram whose sides represent the tints produced by each axis separately, and whose angle is double of the angle formed by the two planes passing through that point of the sphere and the respective axes.

In showing the application of this law, let it be required to find the tint produced at E, fig. 150, by the joint action of the two axes O and AB, whose relative intensities are as 1 to $\frac{1}{\sin.^2 OP}$. Through E draw three great circles AEF, CE, and OE; then let

[1] This must have been a different mineral from that examined by Biot.

Polarisation.

$T =$ tint required at the point E;
$\theta =$ the arch between the point E and the axis O;
$\varphi =$ the arch between the points E and C;
$a =$ the tint produced separately at E by the greater axis;
$b =$ the tint produced separately at E by the lesser axis;
$\psi =$ the angle of the forces;
$\pi =$ the angle CEF;
$\omega =$ the angle OEF;
$A =$ the arch FO, or the angle OAF, or the *azimuth* on the great circle CPO passing through the poles P, P, or centres of the two systems of rings;
$D =$ the arch FE, or the declination or distance of the point E from the same great circle;
$\zeta =$ half the difference of the angles at the base or at the diagonal of the parallelogram of forces.

Then we have

$$\cos.\ \theta = \cos.\ A \times \cos.\ D,$$
$$\varphi = 90° - D,$$
$$\cos.\ \omega = \frac{\tan.\ D}{\tan.\ \theta},$$
$$\cos.\ \pi = \frac{\tan.\ D}{\tan.\ \varphi},$$
$$2\ AEO = \psi = 2\,(180° - \omega) = 2\,\omega.$$

Since, then, the tints a, b produced at E by the axes O and AB are as the squares of the sines of the distance of E from these axes, or as $\sin.^2$ OE and $\sin.^2$ AE, and as the relative intensities of the axes are as 1 to $\frac{1}{\sin.^2 OP}$, we shall have

$$a = \sin.^2 OE, \text{ and } b = \sin.^2 AE \times \sin.^2 OP.$$

Having thus found the sides of the parallelogram of forces whose angle is ψ, the diagonal T of this parallelogram, or the *compound tint* at E, will be obtained in the following manner:

$$\text{Tan. } \zeta = \frac{a - b \tan. \frac{1}{2}\psi}{a + b}, \text{ and}$$
$$\zeta + \tfrac{1}{2}\psi = \text{greater angle at the base.}$$
$$\text{Hence } T = \frac{a \sin.\ \psi}{\sin.\ \zeta + \frac{1}{2}\psi}.$$

When $a = b$, $T = 2a\,(\cos.\ \pi + \omega)$.
When $a = b$ and the two axes O, and AB equal $\pi = \omega$ and $T + 2a\,(\cos.\ 2\pi)$.
When twice the angle formed by the planes OE, AE or

$$\psi = 90°, \text{ then } T = \sqrt{a^2 + b^2}.$$

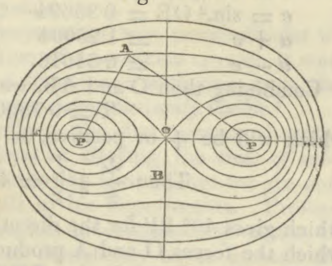
When $\psi = 180°$, $T = a - b$.
When $\varphi = 0°$ or $360°$, $T = a + b$.

Such is the method of determining the tints, and consequently the form of the isochromatic curves in relation to the real axes to which the forces refer; but in relation to the poles P, P, the law of the tints may be more simply expressed by the formula $T = t \sin.\ PE \times \sin.\ P'E$, where t is the maximum tint at A, which must be previously determined. This rule was deduced by M. Biot mathematically from Sir David Brewster's law, and it was afterwards established experimentally by Sir John Herschel, without being aware of its having been deduced from the general law.

The preceding general law is equally applicable when the rings are formed in homogeneous light.

Sir John Herschel,[1] in examining the systems of biaxal rings, found that they resembled lemniscates, as represented in the annexed figure. In these curves the rectangle $PE \times P'E$ is invariable throughout each curve, and the value of this constant rectangle in any one curve is $a \times b$, b being the parameter of the curve, and a half the distance between the poles P, P. The quantity a is of course the same for each curve, but b in different curves increases in the arithmetical progression 0, 1, 2, 3, &c. for the several dark intervals of the rings, beginning at the poles, and in the progression $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, &c. for the brightest intermediate spaces.

Fig. 151.



Many interesting conclusions have been deduced from the preceding general law by Sir David Brewster. When the two *negative* axes O and AB, fig. 150, are of equal intensity, then their action will be compensated at C and D, and C D will be a single *positive* axis of double refraction, and also of an uniaxal system of rings like those in *zircon;* and the isochromatic curves given by the preceding formulæ will be circles surrounding the axis. Hence it follows, *that two negative rectangular axes of double refraction and polarisation compose a single positive axis.* If we now suppose a negative axis at CD, equal in intensity to any of the other two, it will evidently destroy the *positive* axis of compensation at CD, so that three equal and similar *negative axes in any crystal destroy each other;* and hence our author was led to the conclusion, that all the tessular crystals in which there was neither double refraction nor polarisation had three such axes. But if the *third* axis at CD is not equal to O or AB, and if O and AB are unequal, then we shall have all the phenomena of a crystal with two axes. In order to compute the tints thus produced by *three* unequal axes, let O, AB', and CD be three axes, and P, P' the centres of the double systems of rings which they produce. We have already shown that the resulting tint of two axes O and AB, at any part E, is

$$T = \frac{a \sin.\ \psi}{\sin.\ \zeta + \frac{1}{2}\psi}.$$

In order, however, to combine this tint with another, we must know the direction of it. Since ψ is the double of the real angle of the planes in which the forces from O and AB act, the direction of the new plane in which these forces act must form an angle with the real direction of O, whose complement is

$$\frac{\frac{1}{2}\psi + \zeta}{2} \text{ or } \frac{\psi}{4} + \frac{\zeta}{2},$$

or it forms with the real direction of A an angle whose complement is

$$\frac{\frac{1}{2}\psi - \zeta}{2} \text{ or } \frac{\psi}{4} - \frac{\zeta}{2}.$$

Hence the direction of the resultant in relation to BE, the direction of the third force with which it is to be combined, is known.

In order to illustrate this in a case where the truth of the result will be immediately seen, we shall take the case of three equal axes, the general resultant of which is *nothing.* In fig. 150, let O, AB, and CD be the three equal axes, and E the point where we require to know the effect of their combined action. Take AE = 70°, CE = 60°, then EG = 30°, EF = 20°, AG = 66° 44', OG = 23° 16', OE = 37° 17'; then

[1] Treatise on Light, sect. 903.

Polarisation.

$$a = \sin.^2 AE = 0{\cdot}883104 \qquad \psi + \begin{cases} 237^\circ\ 16' \\ 122^\circ\ 54' \end{cases}$$
$$b = \sin.^2 CE = 0{\cdot}7500 \qquad \zeta = \ 37^\circ\ 12'$$
$$c = \sin.^2 OE = 0{\cdot}36694 \qquad \omega = \ 40^\circ\ 4'$$
$$a + c \quad = 1{\cdot}25004 \qquad \pi = \ 77^\circ\ 52'$$
$$a - c \quad = 0{\cdot}51616.$$

Combining then O and AB, we shall have

$$T = 0{\cdot}7500,$$

which will be + or positive, as ψ is greater than 180°.

$$\text{Then } \frac{\psi}{4} + \frac{\zeta}{2} = 49^\circ\ 19',$$

which gives 40° 21′ for the direction of the new plane in which the forces O and A produce the combined tint of 0·7500. But the angle ω or OEG = 40° 41′, so that the resultant lies in the plane CEG; and hence, if we combine with this resultant, or + 0·7500, the force — 0·7500, produced by CD, the result will be *nothing*. This method is also applicable to the combination of axes of double refraction, the numbers corresponding to *a*, *b*, *c* being in that case the difference between the squares of the velocities of the ordinary and extraordinary rays, as produced by each axis separately at the point E.

The following table of the intensities of the polarising force in biaxal crystals has been given by Sir John Herschel:

	Value of the Highest Tint.	Thicknesses that produce the same Tint.
Nitre	7400	0·000135
Anhydrite, angle of axis 43° 48′	1900	0·000526
Mica, angle of axes 45°	1307	0·000765
Sulphate of barytes	521	0·001920
Heulandite (white), angle of axes 54° 17	249	0·0004021

The numbers belong to the *yellow* ray.

Sect. X.—*On Conical Refraction in Biaxal Crystals.*

Conical refraction.

The phenomenon of conical refraction seen along the axes of biaxal crystals was deduced by Sir W. Hamilton from the undulatory theory, and was discovered experimentally and examined by Professor Lloyd in *arragonite*. It followed from the theory, that a single ray, proceeding from a point within the crystal, and emerging at each of the four poles, must be divided into an *infinite number* of emergent rays, constituting a conical surface; and that a single ray incident externally would be similarly divided.

In order to examine the emergent cone formed in air, Professor Lloyd placed a lens of short focus at its focal distance from the first surface of a plate of *arragonite* 0·49 of an inch thick, having its parallel faces perpendicular to the principal axis of the crystal, and so that the central part of the pencil might have an incidence nearly parallel to the optical axis. He then looked through the crystal at the light of a lamp placed at a considerable distance, and observed a point more luminous than the space around it, having a sort of stellar radiation. In order to examine this phenomenon, he placed a plate of thin metal, having a minute aperture, on the surface of the crystal next the eye, and adjusted the aperture so that the line connected with the luminous point on the first surface might be in the direction of the optical axis. When the adjustment was complete, there appeared at first a luminous circle with a small dark space in the centre, and in this dark central space were two bright points, separated by a narrow and well-defined dark line, as shown in Plate CCCLXXXIV. figs. 39 and 40. When the aperture in the plate was slightly shifted, the phenomena rapidly changed, assuming successively the forms shown in figs. 41, 42, 43. In the first stage of the change the central dark space became greatly enlarged, and a double sector appeared in the centre. The circle was reduced to about a quadrant, and was separated by a dark interval from the sector just mentioned. This is shown in fig. 41. The remote sector then disappeared, and the circular arch diminished, as in fig. 42; and as the inclination of the internal ray to the optical axis was farther increased, these two luminous portions merged gradually into two doubly-refracted pencils. This change is shown in fig. 43. In these experiments the emergent rays were received directly by the eye placed close to the aperture on the second surface.

Professor Lloyd succeeded in showing the phenomena on a screen with the sun's light, and he found the light sufficiently distinct when the diameter of the section was one and a half inch. Upon examining the cone with a tourmaline, Professor Lloyd was surprised to observe that one radius only of the circular section vanished in a given position of the tourmaline, and that the ray which disappeared ranged through 360°, as the tourmaline was turned through 180°, the rays of the cone being all polarised in different planes. Upon a more attentive examination he discovered the remarkable law, "*that the angle between the planes of polarisation of any two rays of the cone is half the angle between the planes containing the rays themselves and the axis.*" The angle of the cone was found to be 6° 24′, 5° 56′, and 6° 22′; the mean of which is 6° 14.

When the aperture was considerable, such as that formed by a large-sized pin, two concentric circles were seen to surround the axis, the inner one being nearly twice as bright as the outer one, and consisting of unpolarised light, while the outer one was polarised according to the preceding law. By using smaller apertures the inner circle grew less, until it became a point in the centre of the fainter exterior circle, which remained fixed. With a still less aperture a dark space sprung up in the centre, increasing as the aperture diminished, until, with a very minute aperture, the breadth of this central space increased to about three fourths of the entire diameter. In these cases the appearances are as shown in figs. 44 and 45. When the line joining the luminous point on the first surface was slightly inclined to the axis, the appearance was that shown in fig. 46.

Professor Lloyd observed an interesting variation in the phenomena, by substituting a *narrow linear aperture* for the circular one on the first surface of the crystal, this aperture and the one in the plate next the eye being in the plane passing through the optic axes. The line had the appearance shown in fig. 47, swelling out into the form of an oval curve round the optical axis. By using a very minute aperture next the eye, the phenomenon was as shown in fig. 48. When the plate next the eye was slightly shifted, so that the plane passing through the aperture did not coincide with the plane of the optic axes, the curves rapidly changed, preserving, however, the form of the conchoid, whose pole was the projection of the axis of the emergent cone, and asymptote the line on the first surface. These effects are represented in figs. 49 and 50.

The second kind of conical refraction deduced theoretically by Sir W. Hamilton takes place when a single external ray is incident upon a biaxal crystal, so that one refracted ray coincides with an optic axis. In this case there should be a cone of rays within the crystal, the angle of the cone in arragonite being 1° 55′. As this cone will have its rays refracted at emergence, in a direction parallel to the incident ray, they will form a small cylinder of rays in air, the character of whose section by the surface of emergence being only 1° 55′ at a distance equal to the thickness of the crystal.

In order to detect the existence and measure the size of this cylinder, Professor Lloyd used the light of a lamp placed at some distance, and he made its light pass through two small apertures placed in a straight line, the

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one in a screen near the flame, and the other in a plate of metal close to the first circle of the crystal. Under ordinary circumstances, the incident ray will be doubly refracted within the crystal, and the two pencils will emerge parallel to the second surface. Professor Lloyd was able to distinguish these two pencils by means of a lens; and turning the crystal slowly, so as to vary the incidence, he observed a position in which the two rays changed their relative places rapidly on any slight change of incidence, and appeared at times to revolve round one another as the incidence was changed. Being convinced that the ray was now at the critical incidence, Professor Lloyd changed the position of the crystal relative to the incident ray very slowly; and after much care in the adjustment, he at last saw the two rays spread into a continuous circle, and exhibit the phenomena which we have already described in his own words in our history of Optics.

Professor Lloyd measured the angle of the cone by an indirect method, and found it 1° 50′, differing only 5′ from the angle deduced from theory.[1]

Sect. XI.—*On the Effect of Pressure and Heat on the Double Refraction of Crystals with One, Two, and Three Axes.*

Influence of pressure.

The influence of pressure and heat in modifying the doubly-refracting structure of bodies that previously possessed that property, and of creating a new doubly-refractive structure in uncrystallized bodies, was first studied by Sir David Brewster.[2]

By applying compressing and dilating forces to minerals, he succeeded in altering their doubly-refracting structure in every direction; but the effect was always most easily seen when it was produced along the real axes of uniaxal crystals, or the resultant axes of biaxal ones, where the effect of the natural forces was either nothing, or compensated. The following were some of the results to which he was led by applying the forces to parallel surfaces.

Axis of Compression and Dilatation parallel to the Axis of the Crystal.

Positive crystals....	Compressed...	Tints rise in Newton's scale.
	Dilated.........	Tints descend in Newton's scale.
Negative crystals...	Compressed...	Tints descend in Newton's scale.
	Dilated.........	Tints rise in Newton's scale.

Axis of Compression and Dilatation perpendicular to the Axis of the Crystal.

Positive crystals....	Compressed...	Tints descend in Newton's scale.
	Dilated.........	Tints rise in Newton's scale.
Negative crystals...	Compressed...	Tints rise in Newton's scale.
	Dilated.........	Tints descend in Newton's scale.

The axis of compression and dilatation is the line perpendicular to the two surfaces pressed together or drawn asunder.

The above results were obtained by experiments both on uniaxal and biaxal crystals.

When the axis of compression was perpendicular to the axis of double refraction of an *uniaxal* crystal, it was partially converted into a biaxal one with two axes, *the poles of the two resultant axes being distinctly visible.*[3]

Influence of heat.

M. Fresnel was, we believe, the first person who observed the influence of heat in altering the *tints of sulphate of lime* perpendicular to the laminæ, but we are not able to refer to the details of his experiments. Professor Mitscherlich, however, has investigated the action of heat upon this mineral so completely as to include all previous experiments in his results. Having found that heat acts upon calcareous spar differently in different directions, expanding it in the direction of its axis, and slightly contracting it in directions perpendicular to the axis, he sought to determine if any variation in the double refraction was produced by heat. By the method of interferences, and observing the compensation produced by crossing plates of crystals at different temperatures, he observed that a change in the double refraction was produced.

Mitscherlich.

In extending these experiments, Professor Mitscherlich found that the two resultant axes of sulphate of lime inclined 60° to each other at common temperatures, approached each other when heated, till they met, and constituted one axis of double refraction. By increasing the heat they again separated *in a plane perpendicular to the laminæ.* In this experiment the principal axis of double refraction which bisected the optic axes gradually increased, while the second real axis perpendicular to the laminæ diminished and disappeared when the crystal assumed the uniaxal state. A new axis then sprung up in the plane of the laminæ perpendicular to the principal axis.

Sir John Herschel.

Sir John Herschel, in mentioning this remarkable experiment, states that he observed the tints of a plate of sulphate of lime *rise* rapidly in the scale when the plate was moderately warmed by the heat of a candle held at some distance below it, and sink again when the heat was withdrawn. He found, on the contrary, "that mica similarly heated undergoes no apparent change in the position of its axes, or in the size of its rings, though heated nearly to ignition."[4]

Recent experiments.

The extraordinary experiment of Professor Mitscherlich was repeated by Sir David Brewster with one of the specimens of sulphate of lime, in which he discovered one of the resultant axes of this mineral. The following is the account which he has given of this experiment, and of the discovery of a still more curious property in *glauberite.*[5] "The specimen of sulphate of lime was about one and a half inch thick in the plane of the laminæ, and the system of rings which surrounded this axis was exceedingly minute, with the usual black brush at each end of them. The other system of rings could not be seen in this specimen, owing to the manner in which it was cut. Having brought the crystal to a considerable heat, and exposed it to polarised light, it was a singular sight to see the system of rings travelling along towards the line which bisects the optic axes, like a celestial body passing through the field of a telescope, and changing their form and size as they advanced. The specimen did not permit me to see the two systems unite, and still less to see them open out

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[1] See Irish Transactions, 1833, vol. xvii.; and London and Edinburgh Philosophical Magazine, 1833, No. 8, p. 112, No. 9, p. 207.

[2] Phil. Trans. 1815, p. 1, 60, 1816, p. 167; and Edinburgh Transactions, vol. viii. p. 281.

[3] Edinburgh Transactions, vol. viii. p. 285.

[4] Treatise on Light, sect. 1113.

[5] Lond. and Edin. Phil. Mag. December 1832, vol. i. p. 417.

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again in a plane at right angles to the laminæ; but from the degree of heat which I used, and which drove off the water of crystallization from part of the specimen, I presume that the complete phenomenon cannot be developed without destroying the constitution of the crystal; that is, that after the two systems of rings have opened out in a new plane, they will not return, by cooling, through their state of union, into their primitive inclination of 60° in the plane of the laminæ.

"A property of a similar kind, but perhaps a still more extraordinary one, I discovered some years ago, subsequent to Professor Mitscherlich's discovery; and I have slightly noticed it in a paper on glauberite, published in the Edinburgh Transactions.[1] This interesting mineral has at ordinary temperatures the curious property of *two axes of double* refraction for *red* light, and only *one axis* for *violet* light. If we apply heat to it, the two optic axes for red light gradually close, and, at a temperature which the hand can endure, the two systems of rings for red light have united into one system, so that the crystal has now only one axis of double refraction for red light. By continuing to increase the heat, the two axes separated, and the single system of rings opened out into two systems, lying in a plane at right angles to that in which they were placed at first. The heat was now less than that of boiling water. By increasing it, the inclination of the optic axes gradually increased.

"I now applied artificial cold to a crystal of glauberite at the ordinary temperature of the atmosphere. The inclination of the optic axes for red light increased, as might have been predicted; but, what was very unexpected, a *new axis was created for violet light*, the plane of the two violet axes being coincident with the plane of the two red optic axes at and below the ordinary temperature. An increase of cold increased the inclination of the optic axes for all the colours of the spectrum; the inclination of the axes being *least* for the *most refrangible*, and *greatest* for the least refrangible rays.

"These results appear very complicated when we begin with the effects at an ordinary temperature, and view them in the manner in which they were observed; but if we commence the experiments at a low temperature, such as the freezing point, the order and connection of the phenomena will be more easily understood.

"At 32° glauberite has two axes of double refraction for rays of all colours, the inclination of the axes for the violet rays being least, and that for the red the greatest. As the temperature rises, the optic axes for all colours gradually approach, and the axes for violet first unite into one. At this time the crystal has two axes for all the other colours; but as the heat increases, all the other pairs of axes unite in succession, and form a single system of rings. But before this has taken place, the axes for violet rays have opened up again in a plane at right angles to that in which they originally lay, and they are followed by all the other pairs of axes; so that at a temperature much below that of boiling water, each pair of axes appears with different inclinations arranged in a new direction.

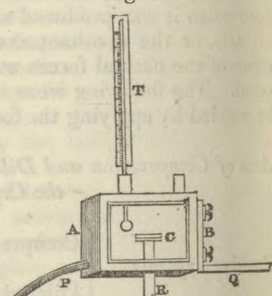
"During all the changes which have been described above, the crystal has preserved its constitution; and by abstracting the heat, the phenomena are all repeated in an inverse order.

"If the crystal should happen to be observed at that temperature, which very often occurs when the greenish-yellow or most luminous rays have the optic axes corresponding to them united, or form a single system of rings, then the blue rays will have two systems of rings lying in one plane, and the red rays also two systems of rings in a plane at right angles to this. In two rectangular positions, namely, when the planes of the double axes coincide with or are at right angles to the plane of primitive polarisation, the black cross will be very distinct; but in intermediate positions it will be much less so, and the uniaxal system of rings which predominates, from the greater intensity of their light, will have that indistinctness of character which, whenever it occurs, indicates a peculiar action of the doubly-refracting force on the differently-coloured rays. When the black cross is perfect and equally distinct in all positions, while the colours of the rings deviate from those of Newton's scale, then the axes for all colours are obviously coincident, and the peculiarity in the colour of the rings is owing to an irrationality in the action of the doubly-refracting forces on the differently-coloured rays."

A series of highly valuable experiments on the changes which temperature produces in the double refraction of crystals,[2] have been made by Professor Rudberg of Upsal. Professor Mitscherlich having only determined the ratio between the mean double refraction of Iceland spar in a cold and in a heated state, without ascertaining the separate variations in each pencil, Professor Rudberg was desirous of supplying this desideratum.

For this purpose he constructed a box, AB, having four of its faces double, so as to enclose a space which received through the pipe P, and retained, the steam from a boiler. This space communicated also with the external air. The other two faces of the box were formed with plates of mica. The inner box, therefore, contained only air, which was heated by the surrounding steam. A thermometer T indicated the temperature of the air. A tube R, passing through the two lower surfaces of the box, formed a free communication between the interior and the exterior air, so that their elasticity was the same. Through this tube R, without touching its sides, there rose from the centre of the repeating circle a vertical copper rod, carrying a plate C, upon which the crystal was placed. This rod was attached below to another plate of copper, which rested on a ring of copper, which, having teeth upon its circumference, could be moved by a screw. By this arrangement he could perform the experiments as readily as if there had been no heating apparatus to obstruct them. The heating apparatus was attached by a rod Q of iron rising from the masonry on which the repeating circle rested.

Fig. 152.



The experiments were made to determine the index of refraction of the ray F of Fraunhofer's spectrum near the boundary of the *green* and *blue* spaces. In this way he obtained the following results.

1. Calcareous Spar. Refracting angle of prism 59° 55′ 9″.

a. Ordinary Ray. The minimum deviation of the line F produced by the prism was 52° 53′ 43″. With a difference of temperature of 64° (Reaumur, we presume), this ray suffered no change in its deviation; from which our

[1] Edin. Trans. vol. xi. part ii. page 273.

[2] This interesting paper was communicated by the author to Sir David Brewster, and published in the London and Edinburgh Philosophical Magazine, December 1832, vol. i. p. 409.

author concluded, *that the refractive power of* CALCAREOUS SPAR *for the ordinary ray either does not change at all with the temperature*, or decreases with it by a quantity *extremely small*. The index of refraction of F at the ordinary temperature was 1·66802.

b. Extraordinary Ray. By the difference of temperature of 64°, the deviation was increased 2′ 26″, or 2′ 34″ when corrected, which gives for the index of refraction,

1·49118 at 64°
1·49075 at ordinary temperature

0·00043 increase.

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Hence, *in the extraordinary ray, a rise of temperature of* 64° increases the index of refraction 0·00343.

Professor Rudberg confirmed this result in the presence of Professor Mitscherlich in 1832.

Rock crystal.

2. ROCK CRYSTAL. Refracting angle of prism 45° 20′ 5″.

In both the ordinary and extraordinary ray, the deviation was *decreased* by a rise of temperature 42″. The indices for the ray F became in the extraordinary ray 1·55868, being 0·00028 more than at the ordinary temperature; and in the ordinary ray, 1·54944, being 0·00026 less.

Arragonite.

3. ARRAGONITE. With four prisms he obtained the following results.

	Prism, No. 1.	No. 2.	No. 3.	No. 4.
Variation of the deviation	— 5′ 8″	— 1′ 53″	— 4′ 3″	— 2′ 58″
Variation of refracting angle	...	+ 16″	— 1′ 53″	— 48″·6

When corrected for the deviation of the plate of mica, they became

Variation of deviation	— 1′ 47″	— 3′ 57″	— 2′ 52″
Variation of angle	+ 30 0	— 1 44	— 40″

Hence he obtained the following indices of refraction:

	No. 2.	No. 3.	No. 4.
At ordinary temperature	1·53478	1·69510	1·69058
At increased temperature	1·53416	1·69421	1·68976
Changes on index	— 0·00062	— 0·00089	— 0·00082

Hence, says our author, *the double refraction of arragonite appears to decrease a little with the temperature*, because the refracting power in the direction of the axis A has diminished in a smaller ratio than that along the axes B and C. In other respects arragonite comports itself quite differently from calcareous spar. The axis A of arragonite obviously corresponds with the axis of crystallization of the spar; but notwithstanding this, the refractive power in this direction diminishes in the former, and, on the contrary, increases in the latter, besides, that in the direction perpendicular to the axis A, the refractive power diminishes considerably in arragonite, whilst, on the contrary, it undergoes almost no change in calcareous spar.

Regular double refraction produced by pressure.

While heat and pressure thus modify the doubly-refracting structure in minerals, they are capable of creating it with *regular axes* in several soft substances. This effect is quite different, as we shall soon see, from that which is produced upon bodies by pressure, where the result is modified by the external form of the body, and where the double refraction disappears when the heat or pressure is removed, or when the body is subdivided. A permanent change is induced upon the soft solids in question, and, when subdivided, each part of the mass or plate preserves the property communicated to it. Sir David Brewster described, in the Philosophical Transactions for 1815,[1] the original experiment which he made on this subject with a mixture of rosin and white wax; but in the same work for 1830,[2] he has given a detailed account of his experiments, and of the conclusions to which they lead respecting the origin of the doubly-refracting structure. The following is the fundamental experiment described by our author.

"I took a few drops of the melted compound (rosin and bees' wax), and placed them in succession on a plate of thick glass, so as to form a large drop. Before it was cold I laid above the drop a circular piece of glass about two thirds of an inch in diameter, and, by a strong vertical pressure on the centre of the piece of glass, I squeezed out the drop into a thin plate. This plate was now almost perfectly transparent, as if the pressure had brought the particles of the substance into optical contact.

"If we expose this plate to polarised light, we shall find that it possesses one *positive* axis of double refraction, and exhibits the polarised tints as perfectly as many crystals of the mineral kingdom. The structure thus communicated to the soft film by pressure does not belong to it as a whole, nor has it only one axis passing through its centre, like a circular piece of unannealed glass. In every point of it there is an axis of double refraction perpendicular to the plates, and the doubly-refracting force varies with the inclination of the incident ray to this axis, as in all regular uniaxal crystals.

"When the two plates of glass are drawn asunder, we can remove one or more portions of the compressed plate, and these portions act upon light exactly like plates of uniaxal mica or hydrate of magnesia, and develope a doubly-refracting force of nearly equal intensity."

Cause of double refraction.

By reasoning from this experiment, our author is led to the opinion that double refraction is acquired by the particles of bodies at the instant of their aggregation, and arises from the pressures produced in the direction of three rectangular axes, by the forces of aggregation. When these forces are very weak, double refraction will not be produced; when they are sufficiently strong and of equal intensity, they will produce tessular crystals; when they are equal in two rectangular directions, they will produce uniaxal crystals; and when they are unequal in all the three directions, they will form biaxal ones. In this way all the phenomena of cleavage may be readily explained.

Upon some substances heat performs the same part as pressure; but our limits will not permit us to detail our author's experiments on this subject.

SECT. XII.—*On the Deviation of the Polarised Tints from those of Newton's Scale.*

In all his investigations respecting the colours of thin plates, M. Biot happened to use only such crystals as

[1] Page 31, 32.

[2] Page 87.

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gave polarised tints similar to those of Newton's scale, and he therefore considered this to be their character. In 1813, however, when Sir David Brewster described the rings in topaz, he gave a list of all the colours in different azimuths round the optic axes, and he not only found these colours to vary in these different azimuths in the same ring, but observed some colours at the extremity of the optic axes. In his paper on the laws of polarisation, published in the Philosophical Transactions for 1818, he remarks, that "in almost all crystals with two axes, the tints in the neighbourhood of the resultant axes, when the plate has a considerable thickness, lose their resemblance to those in Newton's scale, as will be more minutely described in another paper." In April 1817 he communicated to the Royal Society of Edinburgh an account of the extraordinary system of rings in the apophyllite from the Tyrol, which consisted of *purple* and *yellow* light, like the residual colours arising from the combination of irrational spectra.

In examining the colours of the polarised rings in biaxal crystals, he was led to divide them into two classes, viz. 1. Those that had the *red* ends of the rings *inwards*, or between the resultant axes, and the blue ends *outwards*. 2. Those that had the red ends of the rings *outwards*, and the *blue* ends of the rings *inwards*.

The crystals in which the deviation is very striking are given in the following table.

Class 1.—*Red ends inwards.*

Nitre.	Carbonate of lead.
Sulphate of barytes.	Sulphato-bicarbonate of lead.
——— of strontites.	Hyposulphate of strontia (Herschel).
Tartrate of potash and soda.	
Phosphate of soda.	Tartrate of potash.
Arragonite.	

Class 2.—*Red ends outwards.*

Topaz.	Native borax.
Mica.	Sulphate of magnesia.
Anhydrite.	Arseniate of soda.

Unclassed.

Chromate of lead.	Superoxalate of potash.
Muriate of mercury.	Oxalic acid.
——— of copper.	Sulphate of iron.
Oxynitrate of silver.	Cymophane.
Sugar.	Felspar.
Crystallized Cheltenham salts.	Benzoic acid.
	Chromic acid.
Nitrate of mercury.	Nadelstein.
——— of zinc.	Hyposulphate of soda (Herschel).
——— of lime.	

Sir John Herschel found anomalous tints in hyposulphate of lime, and Vesuvian, both crystals with one axis, a circumstance which we ascribe to that axis being the resultant of three axes, two of which are equal.

In examining the rings formed by biaxal crystals, Sir David Brewster found that the black spot at the point of compensation was not in the centre of the rings, and the position of this spot for *topaz* is given in his table of these colours.[1]

Sir John Herschel's experiments.

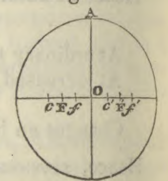
It is to Sir John Herschel, however, that we owe the complete investigation of this subject in reference to biaxal crystals. By using homogeneous light, he found that the angle of the resultant axes POp, fig. 129, was different for the different colours of the spectrum, varying, in the case of *tartrate of potash and soda*, from 75° 42′ in *red* light, to 55° 14′ in *violet* light, so that with *white* light we have a system of rings, consisting of five rings of all colours, overlapping each other, and these five constituting an irregular system, unlike those produced by ordinary crystals.

In crystals where the displacement of the rings is great, the *oval central spots* seen in Plate CCCLXXXIII. figs. 32, 33, and 34, are drawn out, as Sir John Herschel remarked, into long spectra or tails of *red*, *green*, and *violet* light, and the extremities of the rings are distorted and highly coloured, as in fig. 51, Plate CCCLXXXIV. When we view these spectra with coloured media, they are found to consist of well-defined spots of the several simple colours, arranged on each side of the principal section, as shown in fig. 52.

These results are capable of being rigorously calculated by the law of resultant axes given by Sir David Brewster, and may be considered as a proof of that law. If this were not the case, *tartrate of potash and soda* would have two axes for every different ray of the spectrum, and four series of poles extending each over a space of *ten degrees.*

In order to show how these phenomena may be calculated by two axes, let O and A, fig. 153, be two negative axes, which in *red* light compensate each other at F and F; then, if O and A had the same proportional action on the *violet* and other rays as on the *red* rays, F would also be the point of compensation for the *violet* and other rays. In this case F would be the centre of all the systems of rings, as in uniaxal crystals, and the tints those of Newton's scale. But if the axis O has a greater proportional action upon the violet and other rays than A, the point of compensation will be at f, which will be the centre of the violet system of rings, the centres of all the other systems being between F and f if the action of O upon them is of an intermediate nature. This is the case with all the crystals in Class 1 of the foregoing table. On the other hand, if O has a less proportional action on the violet than on the red, c, c will be the points of compensation for the *violet* rays, and the centres of the two systems of violet rings.

Fig. 153.



The most remarkable instances of deviated tints are those in *apophyllite*, a crystal with one axis, discovered by Sir David Brewster. Sir John Herschel, in examining a number of apophyllites, found that some specimens exercise *negative* action upon the rays at one end of the spectrum, a positive action upon rays at the other end, and no action at all upon the mean refrangible rays, the doubly refracting action ceasing, in the one case, in the yellow rays, and in another in the indigo.[2] In other specimens, the diameter of the rings was nearly the same for all the colours of the spectrum, and hence the rings were approaching to a series of black and white ones. All these phenomena may be separately calculated by the law of resultant axes already mentioned, on the supposition that apophyllite has three rectangular axes of double refraction. Sir David Brewster had discovered, in the tesselated apophyllite, portions which had *two* axes co-existing with portions that had *one* axis; and in his coloured drawings of the phenomena exhibited by this mineral, he has pointed out a most extraordinary law of symmetry which regulates its varying double refraction; and as he had shown that a double dispersive power existed in the same crystal, the following explanation of the remarkable phenomena of apophyllite approaches to the character of demonstration.

Let O be the positive axis of uniaxal apophyllite, and let A and B be two *positive* axes which, if equal, would produce a *negative* axis at O. But as the real axis at O is a positive one, the apparent or finally resultant axis at

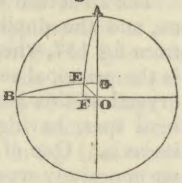
[1] Phil. Trans. 1814, p. 204, 205.

[2] Cambridge Trans. vol. i. p. 21-24.

Polarisation.

O will be a single axis, *negative* if the *negative* is the strongest, and positive if the positive is the strongest. Let us now suppose that the two axes at O have equal intensity, viz. $+ O = - O$ for *yellow* light ($- O$ being the resultant of $+ A$ and $+ B$), and that $- O$ acts more powerfully upon the *red* rays than $+ O$, while $+ O$ acts more powerfully upon the *violet* rays. In this case the two axes $+ O$, $- O$ will exactly compensate each other. In *yellow* light, a yellow ray will experience neither double refraction nor polarisation; whereas in *red* light, the predominance of $- O$ will leave a single negative axis for *red* rays, and produce a *negative* system of rings; and in *violet* light the predominance of $+ O$ will leave a single *positive* axis of double refraction for violet rays, and consequently a *positive* system of rings. This compensation resembles that of a compound lens, consisting of a *convex* and *concave* lens of equal curvature, of such a glass that their refractive index for *yellow* light is equal, while the index of refraction for the *violet* rays is *greater* in the *convex* lens, and the index for the *red* rays *greater* in the *concave* lens. Such a lens will *converge* the *violet* rays, *diverge* the *red rays*, and *produce no deviation* at all in the *yellow* ones; that is, the same compound lens will be a *plane* lens in *yellow* light, a *convex* one in *blue* light, and a *concave* one in *red* light. Hence each order of colours in apophyllite is as it were a secondary or residual spectrum arising from the opposite action of unequal negative and positive axes. From the fact of some apophyllites exercising a negative action, Sir David Brewster stated his expectation that apophyllites might be found in which the double refraction is negative for all the rays of the spectrum; and several years afterwards he discovered the remarkable mineral of *oxahverite*, which is an apophyllite with this property.[1]

Fig. 154.



The phenomena of glauberite already described afford an additional illustration of these views.

Sect. XIII.—*On Crystals with Planes of Double Refraction exemplified in Analcime.*

Analcime.

Analcime or *Cubizite*, a mineral which has been ranked among the cubical crystals, might have been expected to have had no double refraction if this had been its form. It was found, however, by Sir David Brewster, to be a singular body in its action upon light, and to exhibit the extraordinary property of many planes of double refraction, or planes to which the doubly-refracting structure was related in the same manner as it is to *one* or *two* axes in other minerals.

Analcime crystallizes most commonly in the form of the *icositetrahedron*, as in fig. 53, Plate CCCLXXXIV. If we suppose a complete crystal of it to be exposed to polarised light, it will give the remarkable figure shown in fig. 53, where the dark shaded lines are planes in which there is neither double refraction nor polarisation, the double refraction and the tints commencing at these planes, and reaching their maximum in the centre of the space enclosed by three of the dark lines. The tints are those of Newton's scale, and are negative in relation to each of the four axes of the *icositetrahedron*. When light is transmitted through any pair of the four planes which are adjacent to any of the three axes of the solid, it is doubly refracted, the least refracted image being the extraordinary one, and consequently the double refraction negative in relation to the axes to which the doubly-refracted ray is perpendicular.

If we suppose the crystal to have the form of a *cube*, the planes of double refraction will be, as in fig. 54, a plane passing through the two diagonals of each face of the cube.

The tints vary as the square of the distance from the nearest plane of double refraction.

The tints shown in figs. 53 and 54 cannot of course be seen at the same time, but are deduced from observations made by transmitting polarised light in every direction through the crystal.

Sect. XIV.—*On the Double Refraction and Polarisation of Composite Crystals.*

Composite crystals.

In all the crystallized bodies whose action upon light we have been considering, excepting *analcime*, the phenomena are identical in all parallel directions, the smallest fragment having the same property as the largest, from whatever part of the crystal it is taken.

In the mineral world, however, and among the products of artificial crystallization, there occur crystals which are composed of several individual crystals whose axes are not parallel. These crystals sometimes occur in such regular symmetrical forms, that mineralogists have long regarded them as simple forms; and it is probable that they would have still been viewed in this light, if they had not been exposed to the scrutiny of polarised light.

One of the most remarkable of these composite crystals is Iceland spar, some specimens of which were observed, even by Bartholinus and Huygens, to exhibit phenomena quite different from those which we have already described. The property which they possessed of multiplying the images of a luminous body seen through them had been carefully studied by Benjamin Martin, Professor Robison, Lord Brougham, Malus, and others; but until the publication of Malus' work on Double Refraction, no sound explanation was given of these remarkable phenomena.

Malus describes the phenomena as produced by fissures parallel to the surface of the variety of this mineral described by Haüy under the name of *chaux carbonatée equiaxe*. He explains the duplication of the images on the supposition that there is a *fissure* or real opening between the conjoined faces of the spar, and he ascribes the varying tints to a cause not adequate to the production of such splendid phenomena,—to the colouring of the thin plate of air included in the fissure. He states correctly, that the secondary images are doubled by *two* fissures, tripled by three, &c.[2]

This class of phenomena was particularly investigated by Sir David Brewster, who found that the fissures described by Malus *were thin crystallized laminæ of Iceland spar*, having their axes of double refraction inclined to that of the portions of the crystal which it separated; that these laminæ varied in thickness, the thinnest producing a large system of rings, and the thicker plates smaller systems, the plates being sometimes so thick that no colours whatever appeared. Hence it was obvious *that each crystal of this kind was a polarising and an analysing apparatus, the thin laminæ being the plate which exhibited its polarised tints in this singular position.*

In order to understand this remarkable structure, we have represented the laminæ in fig. 155 by the planes ABCD, *ebcg*, *afhd* parallel to the edges EGFH, and also to the long diagonals of the rhomboidal faces, or perpendicular to the short diagonal EF. When we look through a crystal with only *one* of these laminæ, we observe the two principal images of the candle A, B, or luminous

[1] Edinb. Journal of Science, No. xiii. p. 115.

[2] *Théorie de la Double Refraction*, p. 194–198.

Polarisation.

body, while at a vertical incidence, and separated just as they would have appeared in a common crystal of the same thickness. But on each side of this double image is a single-polarised image C and D, C being polarised in the same plane as B, and D in

Fig. 155.

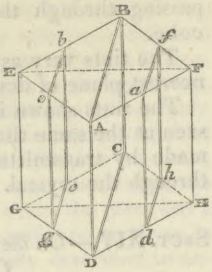
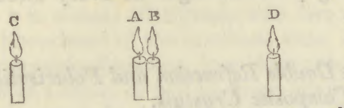


Fig. 156.



the same plane as A. Let us suppose that these phenomena are seen through a rhomb with only one plane ABCD (fig. 155), and through the faces EACD, BEHC. Then, if we incline the rhomb in different directions slightly, we shall see the images C, D disappear when they have a certain distance from A, B. If we incline the rhomb, bringing EA nearer the eye than CD, the images C, D will approach to AB, and will be found to disappear nearer and nearer to AB as the inclination is increased, it being necessary to bring the edge EG nearer the eye than AD, to make C and D disappear. While C and D are thus approaching to A, B, they become less and less coloured till they are all white. If we incline the rhomb in an opposite direction, so that GD is brought nearer the eye than EA, the images C, D recede from A, B, and become more highly coloured, the two images A, B becoming also coloured. The images C, D sometimes appear doubled when this inclination is going on, but it is only a duplicity of colour, so to speak, in consequence of the spectrum being divided by portions of it passing into the reflected pencil. When we bring EC nearer the eye than AD, the colours increase, A and B become also coloured, and an apparent colorific duplication of the images C and D takes place. If the rhomb is inclined in an opposite direction, so that AD is brought nearer the eye than EC, the images C, D become also at first more coloured; but by increasing the inclination, the image C recedes rapidly on the right side from A, B, contracts in breadth, and becomes prismatically coloured, the spectrum which it exhibits being subdivided by several black lines or bands, the parts of the spectrum corresponding to these black lines or dark bands having passed into the reflected ray. The spectrum D recedes as rapidly to the left, expanding in breadth, and even disappearing, as well as the images A, B.

All these phenomena are more finely seen, and the law of their changes more easily detected, if, instead of a candle, we look at a long line of light, such as the narrow opening between the edges of the window-shutters.

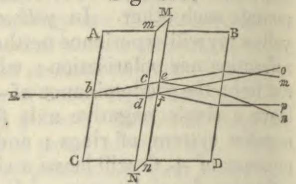
If we look through the faces ADFH, ADEG of the rhomb, placing a prism of glass with an angle of 12° or 15° upon one of the faces, to permit the refracted rays to emerge at a moderate angle of deviation, the prismatic images formerly described will be large spectra, subdivided by black spaces into 4, 5, 6, &c. coloured images of the candle, or of the long luminous line, exhibiting one of the most magnificent phenomena that can be witnessed.

These phenomena vary, of course, with the thickness of the enclosed laminæ, and as the laminæ increase in thickness the subdivisions of the spectral images become more numerous.

When we reflect light from these laminæ, ABCD, for example, by allowing the light to enter by the face BFHC, and emerge through the face AFHD, the boundary of total reflection is marked by a series of brilliant rectilineal fringes, polarised in the same manner as the image C, which is now the lowermost. When the light is transmitted through the laminæ at the boundary of total reflection, by entering through the face BECG, and emerging through AFHD, a series of rectilineal fringes complementary to the former reflected series is seen. They also are polarised in the same plane as C, or the lowermost secondary image, and become much more distinct, by causing the oppositely polarised pencil to disappear.

The structure which produces the preceding phenomena, and the duplication of the images, will be understood from fig. 157, where ABCD is the principal section of a crystal of this kind of Iceland spar, having AD for its axis. One of the laminæ oppositely crystallized is shown at M*m*, N*n*, but much thicker than they are generally, the angles A*m*M, D*n*N being 141° 44′. A ray of ordinary light R*b* will be refracted in the lines *bc*, *bd*. These rays entering the laminæ MN, will be again refracted doubly; but as the vein is so thin as to produce the system of uniaxal rings, the colours will vary with the thickness of the film and the inclination of the ray to the axis of the lamina. The four pencils will emerge from the lamina at *e*, *f*, and will be refracted again, as in the figure, into the pencils *em*, *en*, *fo*, *fp*, the colours of *en*, *fo* being complementary to those of *em*, *fp*.

Fig. 157.



That the multiplication and colour of the images are produced by the causes above explained, has been proved by Sir David Brewster, by actually placing laminæ of different crystals between the prisms AN, BN. In this way, by introducing different films in different azimuths, most beautiful combinations may be produced.

If we grind down the angles A and B, so as to have two faces perpendicular to the axis AB, the uniaxal system of rings is beautifully modified by the action of the lamina MN; and that this was the cause of the singular transformations which the rings experienced in different crystals, was proved by the author above quoted, by inserting laminæ between two plates of the *chaux carbonatée basée* of Haüy, whose natural faces are perpendicular to the axis. These transformations are exceedingly beautiful. Some of them are shown in figs. 55, 56, and 57, one of the rings consisting of eight dark radii, while the complementary system has its inner circle marked with *eight* dark-coloured spots. These rings suffer beautiful changes, both by the motion of the plane round its axes when the analysing plate is stationary, and by the motion of the analysing plate when the rhomb is stationary. In studying these phenomena in a great variety of crystals intersected with one or more laminæ, Sir David Brewster noticed a very remarkable fact. A rhomb of spar which produced in one part of it the transformed systems already mentioned, exhibited a singular effect in another part, where *the crystallization appeared perfect and simple*, and where there were decidedly no veins or laminæ. In one position or azimuth of this crystal, this portion gave, as might have been expected, the regular system of rings with the black cross shown in fig. 29. But upon turning it round 45°, all the rings became *elliptical*, as shown at ABCD in fig. 58, the *first* order of colours in one quadrant having joined the *second* order of colours in the adjacent quadrant. The arms of the black cross took the contorted position *abc*, *def*, the continuations of it afterwards, viz. *am*, *cn*, *do*, *fp* being so very faint as to show the continuity of the elliptical rings. In this figure the rings of the same order are marked with the same figure. The very same phenomenon, which points to important theoretical consequences, was observed by the same author in another rhomb of spar *wholly without veins*, but the rings were not so elliptical as in fig. 58.

This composite structure was discovered by Sir David

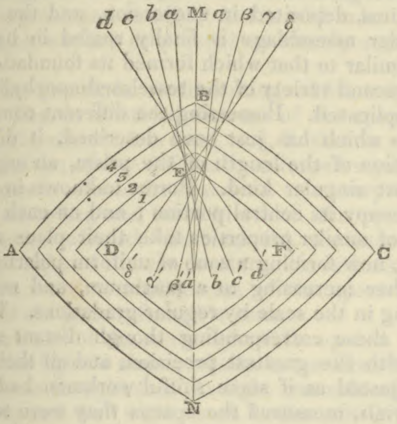
Polarisation.

Brewster in various minerals, and he has described it very minutely in the case of *Brazilian topaz, sulphate of potash*, and *apophyllite*.

Bra…n topa…

Sir John Herschel, we believe, first noticed this structure in Brazilian topaz, and observed that the central portion of the crystal had a different colour from the external portion, and that the plane of the principal section of the different parts made angles of 20 ±°. Sir David Brewster found very remarkable arrangements of the coloured portions, which he has represented in coloured drawings in the Cambridge Transactions, vol. ii. In some of these crystals the structure was tesselated, as in fig. 158, where ABED, CBEF, are the two external tesselæ, at one of the obtuse angles of the rhomboidal section. If we suppose

Fig. 158.



that these tesselæ are divided into *four* laminæ, 1, 2, 3, 4, and that MN is the principal section, or one of the neutral axes of the central portion of the crystal contiguous to DEF, then the laminæ 1, 1 have their principal section in the direction *aa'*, forming a very small angle with MN; the laminæ 2, 2 have their principal section in the line *bb*, and so on to the superficial laminæ 4, 4, which have their principal section in the direction *dd'*, inclined from 10° ± to 22° ± to MN, the inclination varying in different crystals. The lines *aa'*, *bb'*, &c. are also the principal sections of the corresponding laminæ on the side NC. In like manner, the principal sections *αα'*, *ββ'*, &c. of the laminæ in BCFE, are the principal sections of the corresponding laminæ on the other side AN. As the laminæ, however, are infinite in number, the principal sections have every possible direction between *dd'* and *δδ'*.

Sulph… of pot…

The *bipyramidal sulphate of potash*, which Count Bournon supposed to be a simple crystal, was found by Sir David Brewster to be a tesselated crystal, composed of three pair of crystals of the prismatic sulphate of potash combined so that each pair had their principal axis parallel. When exposed to polarised light, each pair gave the system of biaxal rings, and when held at a distance from the eye, had the tesselated appearance shown in fig. 59, Plate CCCLXXXIV., each opposite pair of the triangles having the same tint.[1]

Apoph… lite.

The most remarkable of this class of minerals, and indeed the most remarkable body in the whole mineral kingdom, is the *tesselated apophyllite*. It crystallizes most commonly in four-sided rectangular prisms, like CD, fig. 60. If we remove the uppermost slice A and the undermost B to the thickness of between the 50th and the 100th of an inch, and examine it either by the microscope or by polarised light, we shall find that it is like other uniaxal plates, giving a single system of rays having the very peculiar colours which have been already described. A number of veins appear at the edges, as shown in the figure. All the other slices lying below this exhibit the beautiful tesselated figure shown in fig. 61. The outer case MNOP, which, as it were, binds together the internal portions, consists of a great number of parallel veins or plates, which give the colours of grooved surfaces. This frame encloses *nine* different crystals, namely, the central lozenge *abcd*, the *four* prisms A, B, C, D with trapezoidal bases, and the *four* triangular prisms *ehl, lmn, nkg, gfe*, all of which are separated by distinct lines or veins, which are nearly all visible by the microscope by a proper method of illumination. In polarised light they are all seen with great facility.

The most extraordinary fact connected with this structure is, *that the central lozenge has only* ONE *axis of double refraction, like the terminal plates A, B, fig.* 60, *while the four prisms A, B, C, D, and the four triangular spaces, have* TWO *axes.* In A and D the planes of the resultant axes are coincident, as in the opposite triangles of sulphate of potash, and lie in the direction MN, while the planes of the resultant axes in B and C lie in the direction OP.

When the plate MONP is exposed to polarised light and turned round its axis before the analysing plate, the lozenge *abcd* will be dark in every position of the plate, while the portions A, B, C, D will depolarise the light, or be luminous, when MO or ON are parallel or perpendicular to the plane of primitive polarisation.

Remarkable as is the structure which we have now described, it is greatly excelled in beauty by another variety of Faroe apophyllite, in which Sir David Brewster discovered the most extraordinary organization. He has given an enlarged coloured drawing of the fine symmetrical tints which it exhibits in polarised light, in the Edinburgh Transactions; but we hope its structure may be understood by the following description which he has given of it. The crystals have a greenish-white tinge, and are aggregated together in masses. The quadrangular prisms are in general below one twelfth of an inch in width; they are always unpolished on their terminal planes; they have the angles at the summit more deeply truncated than the other quadrangular prisms from Faroe; they are always perfectly transparent; and may sometimes be detached in a complete state, with both their terminal summits.

"In examining this variety of apophyllite, I was enabled, by the perfection of the crystals, to study their structure through the natural planes, and at right angles to their axes. The phenomena which this investigation presented to me were of a very singular and unexpected nature. In symmetry of form and splendour of colouring they far surpassed any of the optical arrangements that I had seen, while they developed a singular complexity of structure, and indicated the existence of new laws of mineral organization.

"When a complete crystal of this variety of apophyllite is exposed to polarised light, with its axes inclined 45° to the plane of primitive polarisation, and is subsequently examined with an analysing prism, it exhibits, through both its pair of parallel planes, the appearance shown in fig. 62. In turning the crystal round the polarised ray, all the tints vanish, re-appear, and reach their maximum at the same time, so that they are not the result of any hemitropism, but arise wholly from a symmetrical combination of elementary crystals possessing different primitive forms and different refractive and polarising powers. The difference in the polarising powers is well shown by the variation of tint; and the difference of refractive power may be observed with equal distinctness by examining the

[1] See Edinburgh Philosophical Journal, vol. i. p. 1.

Polarisation.

crystal with the microscope under favourable circumstances of illumination, when the outlines of the symmetrical forms shown in fig. 62 will be clearly visible.

"In examining the splendid arrangement of tints exhibited in the figure, the perfect symmetry which appears in all its parts is particularly remarkable. The existence of the curvilineal solid in the centre; the gradual diminution in the length of the circumscribing plates, in consequence of which they taper, as it were, from the angles of the central rectangle to the truncated angles at the summits; but, above all, the reproduction of similar tints on each side of the central figure, and at equal distances from it, cannot fail to strike the observer with surprise and admiration.

"The tints exhibited by each crystal vary, of course, according to its thickness; but the range of tint in the same plate, and at the same thickness, generally amounts in the largest crystals to three of the orders of colours in Newton's scale. The central portion, and the two squares above and below it, have in general the same intensity, while the four segments round the central portion, and some of the parts beyond each of the squares, are also isochromatic. In the central part the colours have a decided termination; but towards the summit of the prism their outline is less regular, and less distinctly marked; though this irregularity has also its counterpart at the other termination. A part of these irregularities is sometimes owing to the longitudinal striæ on the natural faces of the crystal, so that by carefully grinding these off, the beauty and regularity of the figure is greatly improved.

"In order to ascertain the order of the colours polarised by the crystal, and observe in what manner they passed into one another, I transmitted the polarised light in a direction parallel to one of the diagonals of the quadrangular prism, and thus obtained, as it were, a section of the different orders of colours from the zero of their scale. The result of this experiment, which is shown in fig. 63, was highly interesting, as it displayed to the eye not only the law according to which the intensity of the polarising forces varied in different parts of the crystal, but also the variation in the nature of the tints, and the connection between these two classes of phenomena. At the points in the diagonal *mn*, opposite to *ba* of the crystal, the tints rose to the *seventh* order of colours; and in other two places opposite to *cd*, they were only to the *sixth;* while near the summits at *mn*, they descended so low as the *fourth* order. Hence it follows that the four curvilineal segments, fig. 62, are next to these in intensity; that the central portions of the squares are again inferior to these; and that the weakest polarising force is near the summit of the prisms. At *ab*, the *fourth*, *fifth*, and *sixth* fringes have a singularly serrated outline, exhibiting, in a very interesting manner, the sudden variations which take place in the polarising forces of the successive laminæ.

"Having thus described the structure and properties of the tesselated apophyllite, it becomes interesting to inquire how far such a combination of structures is compatible with the admitted laws of crystallography. The growth of a crystal, in virtue of the aggregation of minute particles endowed with polarity, and possessing certain primitive forms, is easily comprehended, whether we suppose the particles to exist in a state of igneous fluidity or aqueous solution. But it is a necessary consequence of this process, that the same law presides at the formation of every part of it, and that the crystal is homogeneous throughout, possessing the same mechanical and physical properties in all parallel directions.

"The tesselated apophyllite, however, could not have been formed by this process. It resembles more a work of art, in which the artist has varied, not only the materials, but the laws of their combination.

"A foundation appears to be first laid by means of an uniform homogeneous plate, the primitive form of which is pyramidal. A central pillar, whose section is a rectangular lozenge, then rises perpendicularly from the base, and consists of similar particles. Round this pillar are placed new materials, in the form of four trapezoidal solids, the primitive form of whose particles is prismatic; and in these solids the lines of similar properties are at right angles to each other. The crystal is then made quadrangular by the application of four triangular prisms of unusual acuteness. The *nine solids* arranged in this symmetrical manner, and joined by transparent veins performing the functions of cement, are then surrounded by a wall composed of numerous films, deposited in succession, and the whole of this singular assemblage is finally roofed in by a plate exactly similar to that which formed its foundation.

"The second variety of the tesselated apophyllite is still more complicated. Possessing the different combinations of the one which has just been described, it displays, in the direction of the length of the prism, an organization of the most singular kind. Forms unknown in crystallography occupy its central portion; and on each side of it particles of similar properties take their place at similar distances, now forming a zone of uniform polarising force, now another increasing to a maximum, and now a third descending in the scale by regular gradations. The boundaries of these corresponding though distant zones are marked with the greatest precision, and all their parts as nicely adjusted as if some skilful workman had selected the materials, measured the spaces they were to occupy, and finally combined them into the finest specimen of natural mosaic.

"The irregularities of crystallization which are known by the name of *macle* or *hemitrope* forms, and those compound groups which arise from the mutual penetration of crystals, are merely accidental deviations from particular laws which govern the crystallizations in which they occur. The aberrations themselves testify the predominance of the laws to which they form exceptions, and they are susceptible of explanation by assuming certain polarities in the integrant molecules. The compound structure of the apophyllite, however, cannot be referred to these capricious formations. It is itself the result of a general law, to which there are no exceptions, and when more deeply studied and better understood, it must ultimately lead to the introduction of some new principle of organization, of which crystallographers have at present no conception.

"The difficulty of accounting for the formation of apophyllite is in no way diminished by giving the utmost license to speculation. We cannot even avail ourselves of the extravagant supposition of a crystalline embryo, which, like that of animal and vegetable life, gradually expands to maturity. The germ of plants and animals is nourished by a series of organs, of which, however recondite be the operation, we yet see the action and witness the effects; but in the architecture of apophyllite no subsidiary organs are seen. The crystal appears only in its state of perfection; and we are left to admire the skill which presided at its formation, and to profit by the instruction which is so impressively conveyed by such mysterious organization."[1]

We have represented in figs. 66 and 67 the figure produced by polarised light by an internal slice of the barrel or cylindrical apophyllite from Kudlisaet, in Disco Island,

[1] Edinburgh Transactions, vol. ix. p. 323.

brought home by Sir Charles Giésecke. The figures are from different specimens. The *shaded part of them has only one axis of double refraction*, while the *four sectors have two axes*, the luminous sectors being analogous to the prisms A, B, C, D, and the dark figure to the central lozenge *abcd*, in fig. 61. The mechanical structure of the cleavage planes resembles the optical figure even after the planes are ground.[1]

Sect. XV.—*On the Absorption of Light by Uncrystallized Bodies.*

When a beam of light passes through the most transparent media, such as air and water, a certain portion of it *is lost.* This loss of light is particularly apparent in such bodies when a beam of light has traversed a great thickness of the gas or the fluid. This loss of light has been called *absorption*, and the light lost is said to be *absorbed;* a term which we use at present as merely expressing a fact.

There are two kinds of absorption which may be noticed. 1. That in which all the rays of the spectrum are proportionally absorbed or lost; and, 2. that in which different quantities of the differently coloured rays are lost. Those bodies in which the first kind of absorption takes place are *colourless*, and those in which the second kind takes place are *coloured.* In black *ink*, for example, the transmitted light of the sun is white. In red ink it is red, more of the most refrangible rays of the spectrum being lost than of the least refrangible ones.

When a beam of the sun's light falls upon a piece of charcoal, the light is almost wholly lost or absorbed. Sir Isaac Newton thought that the light was reflected or refracted "to and fro" within such bodies till it was lost; but still the question meets us, why is it lost? If it is scattered in all directions it must emerge again from the charcoal, and be visible in some way or other. In order to meet this and other difficulties, the light is supposed to be detained within the body, and somehow or other united to its substance.

In the case of red ink and similar bodies Sir Isaac Newton conceived that the *blue* rays which were lost were reflected by the particles of the ink, while the red rays were transmitted, as in the colours of thin plates; but as we cannot by any process see these *blue* rays, we can only say that they are lost, and the cause of their loss is as difficult to be found as in the phenomena of imperfect colourless transparency.

The following are the general phenomena of coloured absorptions in transparent bodies.

1. *Red* transparent solids or fluids absorb, generally speaking, the blue end of the spectrum.
2. *Blue* substances absorb, generally speaking, the red end of the spectrum.
3. *Green* bodies absorb both the blue and the red ends of the spectrum.
4. *Yellow* bodies absorb the *blue* and part of the *green* of the spectrum.

But when we examine more narrowly the action of coloured bodies on the spectrum, we find that a body may derive its peculiar tint from absorbing two, three, four, up to many hundred separate parts of the spectrum, so that the colour of such a body is the combination of all the parts of the spectrum which are not absorbed. We may infer, however, from the general tint of the body, what parts of the spectrum it has chiefly absorbed. *Red nitrous gas*, for example, must have acted most powerfully upon the blue end of the spectrum, as we have already seen that it does.

Polarisation.

Sir John Herschel.

Three theories of absorption have been recently published, namely, by Sir John Herschel, Baron Wrede, and M. Lamé, all of which are founded upon the undulatory theory. Sir John Herschel conceives that light may be lost within bodies by the interference of different parts of a ray, which, after taking two routes of *different lengths*, meet again in a condition to interfere. This hypothesis has been modified by Mr Whewell in the following manner: "If we conceive," says he,[2] "with Sir John Herschel, a medium which will not transmit vibrations except through certain canals, these canals must have a determinate direction, and therefore such a constitution would give different proportions in different directions. But let a medium consist of certain particles regularly distributed, the intervening space being filled by a medium capable of vibration. Let it be supposed, also, that each vibration, on reaching a medium so disposed, proceeds in part directly and in part by the indirect routes which go *round* some of the particles and rejoin the direct course. We have thus combinations of ramifying and uniting paths, which, though very complex in each direction, are the same in different directions, in consequence of the regular distribution of the particles. If the distribution, though regular, have a reference to certain axes, as in many crystals, the phenomena of absorption may be different in different directions with regard to these axes.

"In this way the theory of ramifying canals comes to coincide with the theory of vibrations, of which parts are differently retarded, and thus interfere with each other; a theory which has been suggested by other authors."

Baron Wrede.

Baron Wrede[3] supposes the particles of a transparent body placed regularly at equal distances, with the ether diffused between them. When a ray of light is propagated directly through this medium, a portion of it encounters some of the particles, and is reflected backwards, then forwards again, and emerges along with the direct ray, so that the reflected and direct portions will be in a state to interfere and destroy each other. This theory, which is analogous to Newton's, or rather the very same as Newton's, is liable to the objection we have already urged to every theory in which the light is supposed to be decomposed by interior reflections. Now, Baron Wrede's hypothesis may explain all the phenomena, such as dark bands and dark lines, which are known to be produced by thin plates of various thicknesses, as Dr Young has stated;[4] and it may even explain those bands and absorptions which have been recently discovered in decomposed glass by Sir David Brewster, where the effects are clearly produced by a combination of a great number of thin plates,[5] but where the reflected light is as copious as the transmitted light. But we cannot conceive it at all applicable to the cases of nitrous gas (to which he has attempted to apply it), and to solids and fluids, in which all attempts have failed to discover any of the reflected rays.

M. Lamé.

The hypothesis of M. Lamé, which we have already stated in our history of Optics, is incompatible with the actual phenomena of absorption. In place of the lines and bands depending on the surface of emergence, the system of lines is determined by the action of the first surface of the body, a fact independent of all theory.

Of all the theoretical views which we have mentioned, we consider those given by Sir John Herschel and Mr Whewell as the most consistent with observation. They re-

[1] Edinburgh Transactions, vol. ix. p. 328.
[2] Report of the Fourth Meeting of the British Association, 1834, p. 551.
[3] Taylor's Scientific Memoirs, part iii.
[4] Elements of Natural Philosophy, vol. i. p. 469.
[5] Phil. Trans. 1837, part ii.

Polarisation.

lieve us from the difficulty of accounting for the reflected light; but though they have this in their favour, they are not founded on any direct data, and indeed were brought forward, as Mr Whewell remarks, "to show that there is no incongruity between the undulatory theory and the phenomena of absorption."

Recent inquiries.

An attempt has been recently made by Sir David Brewster to deduce an explanation of absorption, both in uncrystallized and doubly refracting bodies, from direct experiment; but as the details have not been published, we can only at present give a very general notice of it. Having been led to suppose, along with Dr Young,[1] that a transparent medium transmits light in two separate portions, one passing through its ultimate particles, and the other through its pores, and that these portions reunite continually after each successive separation, Sir David Brewster endeavoured so to combine a number of thin plates, that the light transmitted through the whole should move with different velocities, the differences being so small as to produce interference. This task he found to be a very difficult one, but he succeeded, after many failures, in finding a doubly-refracting mineral upon which he could impress this mechanical condition.[2] When he placed a small aperture upon this crystal, in order to exclude as much as possible all the light which had not experienced any change in its velocity, and looked through it at a well-formed prismatic spectrum, or, what was the same thing, analysed the light transmitted by the plate with a good prism, he was astonished at the sight which was presented to him, not only because it confirmed his views on a subject of such high scientific interest, but from the splendour of the phenomena which it displayed. The spectrum was covered with the sharpest bright and dark lines and bands grouped with all the irregularity of the solar and nitrous gas lines. The bright lines of maximum intensity were variously placed; and in almost every spectrum thus formed there was a narrow band of *pure homogeneous* WHITE *light, incapable of being decomposed by prismatic analysis.* But the interest of this result did not stop here. The spectrum of the *ordinary* differed from that of the *extraordinary* ray, and the brightest lines had a different locality in each of them. Here then we have the phenomenon of dichroism, of the absorption of light in crystallized and uncrystallized bodies, and of bright and dark lines and bands in the spectrum, and of the unequal absorption of rays of the same refrangibility, but differing in colour, all displayed by an artificially produced combination, in which we know that the phenomena are owing to the interference of rays differently retarded. It can therefore scarcely be doubted that the varied phenomena of absorption arise from the differences of velocity in the rays which pass through the ultimate particles and through the pores of bodies. The constitution of the body, or the arrangement of the ultimate particles in the first film on which the light is incident, determines the nature of the absorptive action which the body exercises at different thicknesses.

SECT. XVI.—*On Dichroism, and the Absorption of Common and Polarised Light by Doubly Refracting Crystals.*

The name of *dichroism* or *double colours*, was given very appropriately, by M. Cordier, we believe, to a mineral called *iolite*, which in *common light* exhibited two different colours in different directions. Dr Wollaston and several mineralogists had observed this double colour in certain crystals of palladium, tourmaline, and other crystals. The origin of this singular property was not known till Sir David Brewter investigated its origin in *iolite*, and showed that it was connected with the doubly-refracting structure; that it never occurred in the *tessular* crystals which did not possess double refraction.

The connection of dichroism with double refraction, and its general laws, will be understood from the following observations. In a specimen of *yellow Iceland spar* the *extraordinary* image is of an *orange-yellow* colour, while the *ordinary* image is *yellowish-white.* Along the axis of double refraction the colour of the two pencils is exactly the same, and the difference of colour increases with the inclination of the refracted ray to the axis. Hence the difference of colour increases in proportion to the difference of the velocities of the two rays, and is consequently a maximum in the equator of double refraction, and is the same in all parallels; the colour along the axis being the natural colour of the mineral. This is the invariable law of the phenomena in uniaxal crystals. The following are the observations made by the author already referred to.

Colours of the two Images in Crystals with one Axis.

Names of Crystals.	Colour when its Axis is in the Plane of Primitive Polarisation.	Colour when its Axis is Perpendicular at that Plane.
Zircon	Brownish white	A deeper brown
Sapphire	Yellowish green	Blue
Ruby	Pale yellow	Bright pink
Emerald	Yellowish green	Bluish green
Emerald	Bluish green	Yellowish green
Beryl blue	Bluish white	Blue
Beryl green	Whitish	Bluish green
Beryl yellow green	Pale yellow	Pale green
Rock crystal, almost transparent	Whitish	Faint brown
Rock crystal, yellow	Yellowish white	Yellow
Amethyst	Blue	Pink
Amethyst	Grayish white	Ruby red
Amethyst	Reddish yellow	Ruby red
Tourmaline	Greenish white	Bluish green
Rubellite	Reddish white	Faint red
Idocrase	Yellow	Green
Mellite	Yellow	Bluish white
Phos. of lime (lilac)	Bluish	Reddish
———(olive)	Bluish green	Yellowish green
Phos. of lead	Bright green	Orange yellow
Calcareous spar	Orange yellow	Yellowish white
Octohedrite	Whitish brown	Yellowish brown

Sir John Herschel has found this property beautifully displayed in the sub-oxysulphate of iron, which crystallizes in six-sided prisms. Along the axis the colour is a *deep blood-red*, while through the sides of the prism it is of a *light green* colour. Several tourmalines have also been observed by Sir John to have these same colours along the axis, and at right angles to it. There can be little doubt that this property will be found in every crystal of sufficient thickness that has the property of double refraction. Even if the crystal is colourless, a slight inequality in the intensity of the two images may be observed; and when it is distinctly coloured, the difference of intensity is very easily seen, even when the two colours are not of a different kind.

The phenomena of *dichroism* are best seen in crystals with *two* axes of double refraction, and are well exempli-

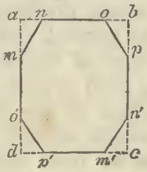
[1] Dr Young made this supposition, not to explain absorption, but to account for the dispersion of colours by refraction. Elem. Nat. Phil. vol. ii. p. 937.

[2] The same property was afterwards found in several crystallized minerals.

fied in *iolite*, a mineral which crystallizes in six or twelve sided prisms. These prisms are of a *deep blue* colour when seen along the axis, and of a yellowish brown colour when viewed in a direction perpendicular to the axis.

If *abcd* is a section of the prism of iolite in a plane parallel to the axis of the prism, the transmitted light will be *blue* through the faces *ab* and *dc*, and *yellowish-brown* through *ad*, *bc*, and in every direction perpendicular to the axis of the prism. If we grind down the angles *a*, *c*, *b*, *d*, so as to replace them with faces *m n*, *m' n'*, and *o p*, *o' p'*, inclined 31° 41′ to *a d*, or to the axis of the prism; then, if the plane *abcd* passes through the resultant axes of double refraction, we shall observe, by transmitting polarised light through the crystal in the directions *a c*, *b d*, and subsequently analysing it, a system of rings round each of these axes. The system will exhibit the individual rings very plainly if the crystal is thin; but if it is thick, we shall observe, when the plane *a b c d* is perpendicular to the plane of primitive polarisation, *some branches of blue and white light, diverging in the form of a cross from the centre of the system of rings*, or the poles of no polarisation, as shown at *p* and *p'*, fig. 67, where the shaded branches represent the blue ones. The summits of the blue masses at *p* and *p'* are tipped with purple, and are separated by whitish light in some specimens, and yellowish light in others. The white light becomes more blue from *p* and *p'* to *o*, where it is quite *blue*, and more yellow from *p* and *p'* to *c* and *d*, where it is completely *yellow*. When the plane *a b c d* is in the plane of primitive polarisation, the poles *p*, *p'* are marked by spots of white light, but everywhere else the light is a deep blue.

Fig. 159.



In the plane *c a d b*, fig. 159, the mineral, when we look through it at common light, exhibits no other colour but yellow, mixed with a small quantity of blue polarised in an opposite plane. The *ordinary* image at *c* and *d* is yellowish brown, and the *extraordinary* image faint blue, the former receiving some *blue* rays, and the latter some *yellow* ones from *c*, and at *a* and *b*, where the difference of colour is still well marked. The *yellow* image becomes *fainter* from *a* and *b* to *p* and *p'*, till it changes into *blue*, and the faint *blue* image is strengthened by other blue rays, till the intensity of the two blue images is nearly equal. As the incident ray advances from *c* and *d* to *p* and *p'*, the faint blue image becomes more intense, and the *yellow* one, receiving an accession of *blue* rays, becomes of a *bluish white* colour. The ordinary image is *whitish* from *p* and *p'* to *o*, and the extraordinary a *deep blue;* but the whiteness gradually diminishes towards *o*, where they are both almost equally blue.

The principal axis of double refraction in *iolite* is negative. The most refracted image is *purplish blue*, and the least refracted one *yellowish brown*.

The following table shows the *colours* exhibited by crystals with *two* axes:

Colours of the two Images in Crystals with two Axes.

Names of Crystals.	Axis of Prism in the Plane of Primitive Polarisation.	Axis of Prism perpendicular to the Plane of Primitive Polarisation.
Mica	Blood red	Pale greenish yellow
Acetate of copper	Blue	Greenish yellow
Muriate of copper	Greenish white	Blue
Olivine	Bluish green	Greenish yellow
Sphene	Yellow	Bluish
Nitrate of copper	Bluish white	Blue
Chromate of lead	Orange	Blood red
Staurotide	Brownish red	Yellowish white
Chloride of gold and sodium	Lemon yellow	Deep orange
Chloride of gold and ammonia	Lemon yellow	Deep orange
Chloride of gold and potassium	Lemon yellow	Deep orange
Augite	Blood red	Bright green
Anhydrite	Bright pink	Pale yellow
Axinite	Reddish white	Yellowish white
Diallage	Brownish white	White
Sulphur	Yellow	Deeper yellow
Sulph. of strontites	Blue	Bluish white
——— cobalt	Pink	Brick red
Olivine	Brown	Brownish white

In the last eight crystals of the preceding table the tints are not given in relation to any fixed line.

In *Withamite*, a crystal whose principal axis is negative in relation to the axis of the prism, the dichroism is beautiful, and is exhibited both in common and polarised light. When common light is transmitted through the two parallel faces of the prism, the tint is of a crimson or amethyst colour, with a mixture of straw colour. Upon turning the crystal round, the yellow tint disappears, and the colour becomes a deep crimson-red. On continuing to turn the prism, the colour changes to a straw-yellow, and at the end of half a revolution the crystal resumes its compound tint. In the groups of crystals which have penetrated the quartz, some of them occupy accidentally the position which gives the yellow colour, others that which gives the red colour, and some that which gives the compound tint, so that, without a knowledge of their dichroitic property, the group might have been considered as composed of three different sets of crystals.[1]

The following table contains the characters of the two pencils in crystals, the number of whose axes has not yet been determined.

Phosphate of iron	Fine blue	Bluish white
Actynolite	Green	Greenish white
Precious opal	Yellow	Lighter yellow
Serpentine	Dark green	Lighter green
Asbestos	Greenish	Yellowish
Blue carb. of copper	Violet blue	Greenish blue
Orpiment	Sulphur yellow	Lighter yellow

Sir David Brewster found that the dichroism of several crystals is changed by heat, and that in some cases this property may be communicated to them. In several coloured glasses, too, he found an analogous property, when they had received the doubly-refracting structure either temporarily or permanently.[2]

Sect. XVII.—*On the Action of the Surfaces of Crystallized Bodies upon Common and Polarised Light.*

It was remarked by Malus, that the action of the surface of Iceland spar upon light is independent of the position of its principal section, and that its surface acts like that of any common transparent body.[3] In examining,

[1] Edinburgh Journal of Science, April 1825, vol. ii. p. 219.
[2] See Phil. Trans. 1819, p. 11; or Edin. Philos. Jour. vol. ii. p. 346.
[3] *Théorie de la Double Refraction*, p. 240, 241; and Biot's *Traité de Physique*, tom. iv. p. 339.

however, the superficial action of this mineral, Sir David Brewster discovered, that all its surfaces, without exception, exercise a remarkable action upon light, and that its polarising angle varied in different azimuths, excepting when the surface was perpendicular to the axis.

If A and A″ are the minimum and maximum polarising angles, viz. in azimuth 0°, or in the plane of the principal section, and in azimuth 90°, or perpendicular to that plane, he found that the variation of the polarising angle was represented by the following expression, where A′ is the polarising angle required at the azimuth a:

$$A' = A + \sin.^2 a \, (A'' - A);$$

in a plane perpendicular to the axis, $A'' - A = 0$, and consequently no change takes place in the polarising angle;
in planes inclined 45° 23′ to the axis on the actual faces of the rhomboid, $A - A = 2° \, 18'$; and
in planes coincident with the axis, $A'' - A = 4°$ nearly.

The following were the measures which our author obtained on the natural faces of the rhomb:

	Azimuth.	Polarising Angle.
Azimuth	0°	57° 74′
	50 57′	58 32
	90	59 32
On faces nearly parallel to the axes:		
Azimuth	0°	54 18
	90	58 14

Sir David Brewster also observed that the polarisation was more complete in azimuth 0° than in azimuth 90° on the faces of the rhomb; but more complete in azimuth 90° than in azimuth 0° in faces parallel to the axis.

As these experiments clearly proved that the forces which produced double refraction extended beyond the surface of Iceland spar, our author became desirous of ascertaining if the light polarised by reflection from the spar suffered any change from the same cause. He therefore thought of weakening the force which produces reflection, in order to allow the interior force to show its weaker influence; and he accomplished this by placing oil of cassia on its surface, and examining the light reflected at the separating surface of the spar and the oil. The experiments which were thus made, and which are detailed in the Philosophical Transactions for 1819, completely proved that the interior force polarised common light out of the plane of reflection, and modified the law of intensity, according to which light is reflected at different angles of incidence.

These experiments excited no attention till 1835, when Professor Maccullagh, of Trinity College, Dublin, began to investigate the laws which regulate the reflection and refraction of light at the separating surface of two media. He had anticipated from theory effects the reverse of those deduced from the preceding experiments; and in order to account for the latter, he was obliged to modify his theoretical views, and was thus led to the result, that when a ray is polarised by reflection from a doubly-reflecting surface, the plane of polarisation deviates from the plane of incidence, except when the axis lies in the latter plane. The formula which expresses this deviation represents very accurately the measures of the polarising angles in different azimuths in the natural faces of the rhomb, the only surface in which the exception is true; but at all other inclinations of the reflecting planes to the axis, the theory and the formula are in fault, for there is a large deviation when the axis or principal section of the crystal is in the plane of reflection.

Professor Maccullagh's success in deducing theoretically the general fact of a deviation increasing as the refractive power of the medium approached to that of the spar, induced Sir David Brewster to resume his inquiries, the general result of which he communicated to the British Association at Bristol in 1836, in the following very brief abstract.

"When light is reflected at the separating surface of two media, the lowermost of which is a doubly-refracting one, the reflected ray is exposed to the action of two forces, one of which is the ordinary reflecting force, and the other a force which emanates from the interior of the doubly refracting crystal. When the first medium is air, or even water, the first of these forces overpowers the second; and, in general, the effects of the one are so masked by the effects of the other, that I was obliged to use oil of cassia, a fluid of high refractive power, in order that the interior force of the calcareous spar which I wished to examine might exhibit its effects independently of those which arise from ordinary reflection. The separating surface, therefore, which I used, had a small refractive power; and the reflecting pencil is so attenuated, especially in using polarised light, that it is almost impossible to use any other light than that of the sun.

"When a pencil of common light is reflected from the separating surface of oil of cassia and calcareous spar, the general action of the spar is to polarise a part of the ray in a plane perpendicular to that of reflection, and thus to produce *by reflection the very same effect that other surfaces do by refraction.*

"On the face of calcareous spar, perpendicular to the axis of the crystal, the effect is exactly the same in all azimuths; but in every other face the effect varies in different azimuths, and depends upon the inclination of the face to the axis of double refraction. On the natural face of the rhomb common light is polarised *in the plane* of reflection, in 0° of azimuth, or in the plane of the principal section; but at 38° of azimuth, the whole pencil is polarised at right angles to the plane of reflection; and in other azimuths the effect is nearly the same as I have stated in my printed paper.

"In order, however, to observe the change which is actually produced upon light, it is necessary to use two pencils, one polarised + 45°, and the other — 45°, to the plane of incidence. The planes of polarisation of these pencils are inclined 90° to each other, and the invariable effect of the *new* force is to augment that angle in the same manner as is done by a refracting surface, while the tendency of the ordinary reflective force is to diminish the same angle. Hence I was led to make an experiment in which these opposite forces might compensate one another. I mixed oil of olives and oil of cassia, till I obtained a compound of such a refractive power that its action in bringing together the planes of polarisation should be equal to the action of the new force in separating them. Upon reflecting the compound pencil from this surface, I was delighted to find that the inclination of the planes was still 90°, and I thus obtained the extraordinary result of a reflecting surface which possessed no action whatever upon common or upon polarised light.

"The action of the new force when the plane of reflection coincides with the principal section of the crystal is obviously inexplicable by any theory of light, though I have no doubt that the undulatory theory may ultimately accommodate itself to this as well as to other classes of phenomena which it does not at present embrace. The difficulty, however, is increased by another result of my experiments, which it is important to notice. On the faces of the spar which are inclined 0°, 45°, 90°, to the axis of double refraction, the action of the new force is symmetrical upon the two pencils of polarised light whose planes are inclined + 45° and — 45° to the plane of incidence; whereas in all intermediate faces, whose inclination to the axes is $22\frac{1}{2}°$ and $67\frac{1}{2}°$, the plane of one of the polarised rays remains stationary, while that of the other is turned round 15°.

"This effect is undoubtedly a very extraordinary one, and indicates some singular structure in calcareous spar, the nature of which it is not easy to conjecture.

"I have examined these phenomena by using, in place of oil of cassia, various fluids whose refractive powers descend gradually to that of water; but it would be a waste of time to give any detailed account of them at present. I shall only state, that the action of the new force becomes weaker and weaker as the force of ordinary reflection is increased, by diminishing the refractive power of the oil which is placed in contact with the spar. With an oil of the highest refractive index, the action of the new force predominates over the feeble power of the ordinary force of reflection. With an oil of a lower index the two forces exactly balance each other; while with oils of still lower indices of refraction, the ordinary force overcomes and conceals the action of the new one.

"Although I have obtained pretty accurate measures of the amount of the deviations produced by the new force, on eight surfaces, differently inclined to the axis, and in various azimuths on these surfaces, yet many experiments are still necessary before we can hope to discover the physical law of the phenomena; and if this should be done, I have no doubt that Mr Maccullagh will be equally successful in the higher attempt of accounting for them by some modification of the undulatory theory."

Sect. XVIII.—*On the Mutual Action of Polarised Rays.*

This curious subject has, we believe, not been studied by any other philosophers but M. Arago and M. Fresnel, and we shall therefore make no apology for giving an account of the results which they obtained, in the words of M. Fresnel himself:[1]—

"In studying the interferences of polarised rays, M. Arago and I found that they no longer exercise any influence upon one another when their planes of polarisation are perpendicular to each other; that is, that they cannot then produce fringes, although all the necessary conditions for their appearance in ordinary cases be scrupulously fulfilled. I shall describe the three principal experiments which illustrate this fact, beginning with that which belongs to M. Arago. It consists in making two pencils, emanating from the same luminous point, and introduced by two parallel slits, traverse two piles of very thin transparent plates, such as those of mica or blown-glass, which are sufficiently inclined to each other to polarise almost completely each of the two pencils, taking care that the two planes are perpendicularly inclined to each other. In this case no fringes can be perceived, whatever care may have been taken thus to compensate the differences of both in varying very gently the inclination of one of the piles; but when the planes of incidence of the piles are no longer perpendicular to each other, they always cause the fringes to appear. In proportion as the planes cease to be parallel, the fringes become weaker, and they disappear altogether when they are rectangular, provided the polarisation of the two pencils has been sufficiently complete. It results from these experiments, that rays polarised in the same plane influence one another, like the rays of light not modified; but this influence diminishes in proportion as the planes of polarisation deviate from one another, and becomes nothing when they are rectangular.

The following is another experiment which leads to the same results. Take a plate of sulphate of lime or of rock-crystal parallel to its axis, and of a uniform thickness; cut it in two, and place each of the halves upon one of the slits of the screen. I suppose that we have turned the two halves in such a way that the edges which were in contact before the division of the plate are parallel, and the axes will also be parallel. But, in this case, we only perceive a single group of fringes in the middle of the bright space as it was before the division of the plates. But, if we turn one of these halves in its plane, thus disturbing the parallelism of their axes, we make two other groups of fainter fringes spring up, situated one on the right, and the other on the left of the group in the middle, and which are completely separated from it, in the white light when the plates of rock-crystal or of sulphate of lime which are used, are only a millimetre thick. It is to be remarked, that the number and breadth of the fringes lying between the middle of one of these groups and the central group, is proportional to the thickness of the plates for crystals of the same kind, or whose double refraction is of the same strength, like rock-crystal and sulphate of lime. In proportion as the angle of the two axes increases, these new groups of fringes become more and more distinct, and attain at last their maximum intensity when the axes of the two plates are perpendicular to each other. In this position, the central group, which had been gradually weakened, altogether disappeared, and is replaced by a uniform light. From this we may conclude, that the rays which produce them, by their interference, are no longer capable of influencing one another.

From the position of these fringes, it is easy to see that they result from the interference of the rays, which have undergone the same kind of refraction in the two plates, since, having travelled with equal velocities, they ought to arrive simultaneously at the middle of the bright space which corresponds to the equal routes, if as we suppose the two plates have the same thickness, and always continue perpendicular to the rays. Hence, the fringes of the central groups were formed by the superposition of those which arise—1. From the interference of the *ordinary* rays of the *left* plate with the *ordinary* ray of the *right* plate; 2. From the interference of the *extraordinary* rays of the *first* plate with the *extraordinary* rays of the *second*. The two eccentric groups, on the contrary, arise from the interference of the rays which have undergone different refractions in the two plates; and as it is the *ordinary* rays which move with the greatest velocity in *sulphate of lime* or *rock-crystal*, we see that, if we employ one of these two species of crystals, the *left* group ought to be formed by the union of the *extraordinary* rays of the *left* plate with the *ordinary* rays of the *right* plate, and the *right* group by the union of the *extraordinary* rays of the *right* plate with the *ordinary* rays of the *left* plate. This being established, it remains now to determine the direction of polarization in each of the pencils which interfere, in order that we may deduce from it what are the relative directions of the planes of polarization which favour or hinder their mutual influence. Analogy shews that the mode of the polarization of light ought to be the same as in the small plates in crystals thick enough to divide it into two distinct pencils. But as this hypothesis might perhaps be an object of discussion, and contradict an ingenious theory of one of our most celebrated philosophers, we shall not present it at first as a certain principle, and we shall have recourse to a direct experiment to determine the planes of polarisation, both of the ordinary and extraordinary rays which emerge from these plates, which we suppose to be one or two millimetres thick. This thickness is sufficient to allow us to cut one of their edges obliquely, and obtain by this prismatic form the separation of the ordinary and extraordinary rays. We then find that they are effectually polarised, the first in the principal section, and the others in a perpendicular direction. If we are not sufficiently convinced that this is their manner of polarisation in emerg-

Polarisation.

[1] We have not seen the original Memoir, but have translated this portion of it from M. Pouillet's very valuable work, entitled *Elemens de Physique Experimental et de Meteorologie*, liv. viii. chap. iii.

Polarisation.

ing from each plate when these two surfaces are parallel, we shall find a new demonstration of this in the facts that we are about to describe, setting out from the principles established by the experiments of M. Arago, and which are besides confirmed by others, of which we are going to speak. If, on the contrary, we no longer question the direction of the polarisation of the ordinary and extraordinary rays, actual experiment will afford us a second demonstration of these principles. When the axes, indeed, of the two plates were parallel, the rays which had experienced the same refractions in the two crystals were found polarised in the same direction, and those of contrary colours in rectangular directions. It is thus that the group of fringes in the middle which proceed from the interference of rays of the same name, had a maximum intensity, and the two others, which resulted from the interference of the rays of contrary names, did not appear again. But when the axes of the two plates formed an oblique angle, of 45° for instance, the rays of a contrary name, and those of the same name, could act at the same time one upon the other, since their polarising planes were no longer rectangular, and the three groups of fringes were produced. When, in short, the axes became perpendicular to one another, the rays of the same colour were polarised in rectangular directions, and the central group, to which it had given birth, vanished, while the *ordinary* rays of the *left* plate were then polarised *parallel* to the *extraordinary* rays of the *right* plate, and this is the cause why the right group which they produce attained its maximum intensity. It is the same with the *left* group, arising from the interference of the *ordinary* rays of the *right* plate with the *extraordinary* rays of the *left* plate.

The following is a *third* experiment, which entirely confirms the results which we have drawn from the first. Having polished a rhomb of calcareous spar upon two opposite faces, wrought with care so as to be quite parallel, I sawed it perpendicularly to these faces, and I obtained in this manner two rhombs of equal thickness, and in which the routes of the ordinary and extraordinary rays were exactly parallel at the same incidence. I placed them one before the other, so that the rays proceeding from the luminous point which had traversed the first rhomb passed through the second, taking care that their faces were perpendicular to the direction of the incident rays; moreover, the principal section of the second rhomb was perpendicular to that of the first, in such a manner that the four pencils which they produced were in general reduced to two; the ordinary pencil of the first rhomb was refracted extraordinarily in the second, and the extraordinary pencil of the first was refracted ordinarily in the second. From this arrangement it followed, that the difference of the route, proceeding from the difference of velocity of the ordinary and extraordinary rays, was found compensated for by the two emerging pencils. They crossed each other, too, at a very small angle, and such that the fringes ought to have had a magnitude much more than sufficient to be seen; and, notwithstanding, though the necessary conditions for the production of the fringes, in ordinary circumstances, were carefully observed, I never could succeed in making them appear.

While I was searching for them with care, holding a magnifying-glass to my eye, I gently varied the direction of one of the rhombs, sometimes to the right, sometimes to the left, in order to compensate the effect resulting from any difference of thickness that might have existed; but in spite of this trial, repeated a great many times, I never could perceive any fringes; and this is not surprising, after what the other experiments have taught us, since the two pencils emerged polarised at right angles to each other. But what proves that the absence of fringes does not depend upon the difficulty of arriving by trials at an exact compensation is, that I easily succeeded in making them appear by employing the light which had been polarised before it entered the rhombs, and in causing it to receive a new polarisation after its emergence. It is, then, completely demonstrable from the experiments which I have described, *that rays polarised at right angles cannot exert any sensible influence upon one another;* or in other words, that their union always produced the same intensity of light, whatever may be the difference of route of the two pencils which interfere.

Another remarkable fact is, that when they have been once polarised in rectangular directions, it is not sufficient that they are brought back to a common plane of polarization, in order that they may give apparent signs of their mutual influence. If in the experiment of M. Arago, indeed, or that which I have described, we cause the rays which have emerged from the two slits, and which are polarized at right angles, to pass through a pile of inclined plates of plane glass, no fringes were perceived, in whatever direction its ray of incidence was turned. Instead of a pile, we may employ a rhomb of calcareous spar, if we incline its principal section at 45° to the plane of polarisation of the incident pencils, so that it divides into two equal parts the angle which they make with each other, each image will contain the half of each pencil, and these two halves having the same plane of polarisation in the same image, ought to produce fringes there, if it is sufficient to bring back the rays to a plane of common polarisation, to re-establish the apparent effects of their mutual influence. But the fringes can never be obtained by this method, as long as the rays have not been polarised in the same plane, before they were divided into two pencils polarised at right angles.

When the light has experienced this previous polarisation, on the contrary, the interposition of the rhomb makes the fringes reappear. The most advantageous direction to give the primitive plane of polarisation, is that which divides into two equal parts the angle of the rectangular planes, in which the two pencils are polarised in the second instance, because then the incident light is equally divided between them. Suppose, in order to fix our ideas, that the primitive plane of polarisation is horizontal, it will be necessary that the planes of polarisation impressed upon each of the two pencils, is inclined 45° to the horizontal plane, the one above it and the other below it, in such a manner that they remain perpendicular. We can obtain this rectangular polarisation either with the help of the two little piles employed in the experiment of M. Arago, or with two plates whose axes are rectangular axes, or, finally, with a single crystallized plate: We shall only consider this last case, the two others presenting phenomena precisely similar.

To divide the light into two pencils, which cross under a small angle, and which may thus produce fringes, the apparatus of two mirrors is generally better than the screen pierced by two slits, because it produces more brilliant fringes. It has, besides, the advantage of giving immediately to the two pencils the previous polarisation necessary to our experiment; it is sufficient for this purpose that the two mirrors should be of glass not tinned, and inclined 35° to the incident rays; care must be taken to blacken them behind, to destroy the second reflection. We place near them, in the line of the reflected rays, and perpendicularly to their direction, a plate of sulphate of lime or of rock-crystal parallel to the axis, and one or two millimetres thick, inclining its principal section 45° to the plane of primitive polarisation, which we have supposed horizontal. The apparatus being thus placed, we only see a single group of fringes across the plate as before its interposition, and it occupies the same place. But if we put before the magnifying-glass, a pile of glass plates, inclined in a horizontal or vertical direction, we discover on each side of the central group another group of fringes, which is the more distant as the crystallized plate is thicker. If we replace the pile of plates by a rhomb of calcareous spar, whose principal section is divided horizontally or vertically, we shall see in each of the two images which it produces, the two systems of additional fringes which the interposition of the pile of plates has caused to appear; and it deserves to be remarked, that these two images are complementary to one another; that is to say, that the obscure bands of the one correspond to the brilliant bands of the other.

We see in this experiment a new confirmation of the principles demonstrated by the preceding ones. The rays which have experienced the refractions of opposite names, cannot influence each other, because, in emerging from the same plate in the case we are now considering, they are found polarised in rectangular directions; consequently the groups to the right and the left cannot exist, at least while we have not re-established the mutual influence of those rays by bringing them to a common plane of polarisation; this is what is effected by the interposition of the pile of plates or of the rhomb. The fringes thus produced are the more distinct, as the two pencils of contrary names which concur in their formation are more equal in intensity; and this is the reason why the direction of the principal section of the rhomb, which makes an angle of 45° with the axis of the plate, is the most favourable to the appearance of the fringes. When the principal section of the rhomb is parallel or perpendicular to that of the plate, the rays refracted ordinarily by the plate pass entirely into one image, instead of being divided between the two, and all the extraordinary rays pass into the other image, so that there can be no more interference between them; and the additional groups of fringes disappear, each image presenting only the fringes which resulted from the interference of the rays of the same name, that is to say, those which compose the central group.

These two groups of additional fringes which polarized light exhibited in the first position of the rhomb, afford one of the most exact methods of measuring double refraction and of studying its law. Their eccentric position, indeed, depends on the difference of route of the ordinary and extraordinary rays which emerge from the plate; and we can judge of the number of undulations by which the extraordinary rays of the right pencil remain behind the ordinary rays of the left one, by the number and width of the fringes comprised between the middle of the right group, and that of the central group. We may determine this difference of route still better, by measuring the interval between the middle of the two extreme groups, which is the double of their distance from the middle of the central group. White light is best suited for this kind of observations, because it is brightest, and renders the central band of each group easier to be observed. By comparing the thickness of the plate with the difference of the observed route, we may deduce from it the ratio of the velocities of the ordinary and extraordinary rays."

Sect. XIX.— *On the Production of Double Refraction by Heat, Cold, Pressure, and slow and rapid Induration.*

The various phenomena of double refraction and the system of polarised rings, may be produced either transiently or permanently in glass and other substances, by heat and cold, compression and dilatation, and by slow and gradual induration. The phenomena thus produced in polarised light are exceedingly beautiful, and throw much light on the subject of double refraction.

Art. I. *On the Transient Influence of Heat and Cold.*

The influence of heat and cold may be exhibited in *cylinders, tubes, spheres, cubes,* and *rectangular plates* of *glass,* all the phenomena of which were discovered by Sir David Brewster.

1. *Cylinders of Glass with one axis of double refraction.*

1. *Negative Axis.*— If we take a cylinder of glass, ACBD, fig. 69, from half an inch to an inch in diameter or upwards, about one-half an inch or more in thickness, and transmit heat uniformly from its circumference to its centre, it will exhibit, when placed between the polarising and the analysing plate, and held about eight or ten inches from the eye, the system of uniaxal rings shewn in fig. 69, exactly similar to those in fig. 29; and by turning round the analysing plate, we shall see the complementary set, as in fig. 31, these rings will be seen as if they were in the substance of the glass, and hence, if we cover up any part of the circular surface, we shall cover up a corresponding part of the system of rings. The axis of the system or of double refraction is here fixed in the axis of the cylinder, and does not lie in every direction parallel to that axis, as in regularly crystallized bodies.

The system of rings thus produced is *negative,* like those in *calcareous spar.*

As soon as the heat reaches the axis of the cylinder, the rings become less bright, and they disappear entirely when the heat is uniformly distributed through the glass.

2. *Positive Axis.*—If we heat a similar cylinder of glass uniformly in boiling oil or otherwise, and cool it rapidly at its edges by encircling its margin with a cold and good conducting material, it will exhibit a similar system, which will vanish when the glass is uniformly cold. This system of rings, however, is *positive,* like those of Zircon, and if it is placed above the equal *negative* system, produced as already described, they will destroy each other. If the two systems are not equal, we shall have a system equal to their difference, as in positive and negative uniaxal crystals. In both these systems the tint at any point varies as the square of the distance of that point from the axis, so that if T is the tint at any distance D, the tint t corresponding to any distance d, will be $t = \frac{\mathrm{T}\,\mathrm{D}^2}{d^2}$. If V is the velocity of the ordinary ray, we shall have the velocity of the extraordinary ray $v = \mathrm{V}^2 + a\,d^2$.

If we transmit polarized light through the cylindrical surface of these cylinders, we shall observe the phenomena of biaxal systems exactly the same, as in rectangular plates, fig. 81, the tints being produced by the action of the positive or negative axis of the cylinder acting in opposition to an axis passing through each diameter of the cylinder, drawn perpendicular to any point in the middle line of the cylindrical surface.

2. *Oval Cylinders, with two axes of double refraction.*

If we perform the two experiments above described with oval cylinders, as in fig. 70, we shall have a system of rings with two axes. A new axis is developed perpendicular to the axis of the cylinder, and in the case of the heated cylinder the new axis at O is a positive one, while in the cooled cylinder it is a negative one, the neutral black lines AD, CB separating the two classes of tints, and corresponding to the dark hyperbolic branches in biaxal systems of rings. The figure referred to is that shewn in azimuths inclined 45° to the plane of primitive polarization; but in the azimuths of 0° and 90°, the branches AD, CB resume the form of the rectangular cross.

3. *Cubes and Parallelopipeds of glass with double refraction.*

Cubes of Glass.— When the shape of the glass is that of a cube as in fig. 71, the figure which it produces in azimuth 0° by the two processes of heating and cooling is that shewn in the figure, the tints being negative or positive according as we apply heat or cold. The complementary system is shewn in fig. 72.

Parallelopipeds of Glass.—In a parallelopiped 0.38 of an inch square, and 1.11 long, the *direct* and *complementary* systems at 0° of azimuth are shewn in fig. 73 and 74. The first of these consist of a black cross, surrounded with beautiful fringes of contrary flexure, and four bright green spots of the third order. The coloured spots at the angles of fig. 74 are of a brilliant pink colour, with a spot of blue in the middle of each. When the azimuth is 45°, the direct and complementary systems change into fig. 75 and 76.

4. *Cylindrical Tubes of Glass with two axes of double refraction.*

When the cylinder has the form of a tube, as in fig. 77, the double refraction is singularly distributed by the application of heat or cold either to the outside ABCD of the cylinder, or to its inside *a b c d*, or to both. A black circular fringe *m n o p*, is the central line which separates the outside or positive structure from the internal negative structure, and *vice versa*. The breadth of the internal annulus *a o* is always less than A *o*, that of the external one. They approach to equality as the bore of the cylinder widens, and the negative structure grows very small, as shewn in fig. 78, when the bore diminishes; so that when the bore becomes infinitely small, the system becomes either wholly negative or positive, according as heat or cold has been used. If when fig. 77 is fully developed, we cut a notch EF in the cylinder, we shall have a biaxal system of fringes in which there is a positive structure between two negative ones, or *vice versa*, as shewn in fig. 79.

The diameter *o p*, fig. 77 and 78, is a geometrical mean between the interior and exterior diameters of the tube, that is $op = \sqrt{(\text{AB} \times ab)}$.

5. *Rectangular Plates of Glass, with planes of double refraction.*

If a well annealed parallelopiped of glass EFCD, fig. 80, is submitted to the processes already described, or even if we lay one edge of it CD on a piece of iron almost red hot, and place the whole between the polarizing and analyzing plates, so that if the heated edge CD is inclined 45° to the planes of primitive polarization, and the eye can see the whole surface of the glass, a series of remarkable phenomena will be produced. The moment the heat enters the lower surface at CD, fringes of brilliant colours are seen above CD, and almost at the same instant, before the heat has reached the upper surface EF, or even the central line *a b*, *similar* fringes will appear at EF. Colours, at first faint blue, then white, yellow, orange, red, &c. of the first order spring up at *a b*, and these central colours are separated from those at the edges by two dark lines or planes MN, OP, corresponding to the hyperbolic branches in biaxal crystals, the double refraction between MN and OP being *negative*, in reference to a line perpendicular to the fringes, while it is *positive* without MN and OP. The tints thus developed are those of Newton's scale.

If T is the central tint in the line *a b*, D the distance of either of the lines MN, OP, from *a b*, the tint *t* at any other distance *d*, will be $t = \text{T} - \frac{\text{T}d^2}{\text{D}^2}$, a formula deduced from the opposition of two axes. The term $\frac{\text{T}d^2}{\text{D}^2}$ represents the influence of the principal axis or axes perpendicular to the line *a b* at every point of it; but as the axis in the plane of the plate produces an uniform tint T, whose maximum is in the line *a b*, where the action of the other axis disappears, and as these axes oppose each other by acting rectangularly, they will compensate each other in the lines MN, OP, and the tint at any point must always be equal to the difference of the tints, or to $\text{T} - \frac{\text{T}d^2}{\text{D}^2}$.

The magnitude 2 D, or the distance between MN and OP, is a function of the breadth of the plate or *b*, and 2 D: V = 10 : 16.02 and D = .312 B².

The fringes seen through the thickness of the plates is shewn in fig. 81, and the one seen through the ends in fig. 82.

If we wish to find the tints in reference to the lines MN, OP, let δ, δ' be the distance of any point from these lines, whose distance from *a b* was *d*, then we have $\delta = 1 - d$, $\delta = 1 - d$ and $\delta\delta' = 1 - d^2$, that is the tint at any point varies, as the product of the distances of that point from the planes of the resultant axes MN, OP. If we make $v^2 = \text{V}^2 + \alpha\delta\delta'$, an expression which gives v the velocity of the extraordinary ray, we shall have the extraordinary refraction in such plates.

6. *Spheres and Spheroids of Glass with double Refraction.*

Spheres.—If we place a sphere of glass in a glass-trough of hot oil or otherwise heat it regularly, we shall find that when the heat is passing to the centre of the sphere, it will exhibit a positive uniaxal system of rings like that in fig. 69, in every direction in which we transmit the polarized light; that is, it will have an infinite number of *positive* axes of double refraction.

If a hot *sphere* of glass is immersed in a glass-trough of cold oil, a similar system of rings will be produced in every possible direction; but it will be *negative*.

Spheroids. If we substitute *oblate* and *prolate* spheroids in place of the sphere in these experiments, we shall find that they will have each a *positive* system of rings round their axis of revolution. If the polarised light is transmitted through an equatorial diameter, we shall find that there are two axes of double refraction, the black cross opening out when the axis of revolution is inclined 45° to the plane of primitive polarisation.

In the prolate spheroid the black cross opens out in a different plane.

7. *On the Effects produced by combining Plates of Glass under the transient influence of heat and cold.*

If we combine any two plates of the same shape, the resulting system of fringes will be equal to the sum of their systems or effects, if the plates are of the same name, that is, both *positive* or both *negative*, or to the difference of their effects, if they are of different names. When the plates are solids or symmetrical forms, such as cylinders, cubes, or quadrangular plates, no essential variation of figure is produced by the combination; but when the plates are rectangular, very interesting phenomena are exhibited when plates of the same or of different names are crossed rectangularly. Sir David Brewster has given formulæ for calculating the forms of the compound or isochromatic curves, as he calls them, but our space will only permit us to exhibit the effects to the eye.

When equal rectangular plates of *similar names*, that is, both negative or both positive, are crossed, the phenomena of the *intersectional fringes*, as they may be called, are shewn in fig. 83, where the isochromatic curves are *hyperbolas*.

When the plates are of *different names*, the one *positive* and the other *negative*, and of the same breadth, and the same number of fringes, the isochromatic curves are *circles*, as in fig. 84.

When the plates are of *different names*, and of different breadths, but containing the same number of fringes, the isochromatic curves will be *ellipses*, as in fig. 85.

8. *On the effects produced by altering the form of, or subdividing plates of glass under the influence of heat or cold.*

If we alter the shape of any of the plates above described, the form of the isochromatic curves is immediately changed. If we cut any rectangular plate into two by a line passing through its middle, each of the two plates thus produced has the property of the whole plate, though the fringes are less numerous. If a plate ABCD gives the tints shewn in fig. 86, OP and MN being the dark neutral lines; then if we cut it with a diamond at ab, so as to subdivide it into two plates, as in fig. 87, each of the plates EFrs, GHrs, will have the same structure as ABCD, viz. two neutral lines op, mn, and assume positive and negative tints.

Art. II. *On the Permanent Influence of Rapid Cooling.*

In March 1814, Sir David Brewster found that glass melted and suddenly cooled, as in the case of Prince Rupert's drops, possessed a permanently doubly refracting power, and he communicated this fact in a letter to Sir Joseph Banks, dated April 8. 1814; and without knowing that Dr Seebeck had published in December 1814 similar results with cubes of glass, our author had discovered that cubes, cylinders, plates, spheres, and spheroids of glass, exhibiting permanently the phenomena described in the preceding pages, may be formed by bringing them to a red heat, and cooling them rapidly and equally on their edges. A great variety of beautiful optical figures, developed in polarised light, may thus be obtained by cooling the glass on metallic patterns. A very simple effect of this is shewn in fig. 88, where the plate of glass was cooled by resting it at its centre on a cylinder of iron.

Art. III. *On the production of Double Refraction by Compression and Dilatation.*

The effects of compression and dilatation in producing double refraction were discovered by Sir David Brewster, and communicated to the Royal Society in 1815. Our limits will permit us to only give a slight notice of them.

The phenomena both of compression and dilatation or extension may be well seen by bending, merely with the force of the hands, a square rod, or a long and narrow plate of glass, as in fig. 89. When it is held between the polarising and analysing plate, eight or ten inches from the latter, with its edge AB inclined 45° to the plane of primitive polarisation, the whole thickness of the glass will be covered with two series of coloured fringes, like those in the figure separated by a dark neutral line MN, where there is neither compression nor dilatation. The fringes on the convex side are *negative*, being produced by the *extension* of the glass in the direction mA, mB, while those on the concave side are produced by the *compression* of the glass in the directions Cn, Dn. The isochromatic curves marked by similar figures, indicating the orders of the colours, are bent as in the figure.

When a plate of bent glass producing fringes crosses another at right angles, the effect at the intersectional space is shewn in fig. 90, where the tint is supposed only to be the white of the first order.

When a plate of bent glass is crossed with a plate crystallized by heat, the fringes in the intersectional square will be *parabolas*, as shewn in fig. 91, whose vertex will be towards the *convex* side of the bent plate, if the principal axis of the other plate is *positive*, but towards the *concave* side, if that axis is *negative*.

Polarisation.

Art. IV. *On the Double Refraction produced by gradual Induration and difference of Density in soft Solids.*

The phenomena of luminous sectors, separated by a black cross at the central part of the uniaxal system of rings, which Sir David Brewster discovered round cavities in the diamond, in glass, and in various gums, arise from the gradual induration of the mass, combined with the elastic pressure of the air included in the cavities: They are therefore not properly cases of induration alone.

When isinglass is dried in a circular trough, it exhibits, by polarised light, the uniaxal system of rings like glass, in fig. 69.

When it is indurated in the form of a rectangular mass, by the exposure of two sides, fringes are produced parallel to these sides, and biaxal like those in rectangular plates of heated glass.

A sphere of transparent jelly or isinglass, when allowed to indurate gradually, will have an axis of double refraction in every direction, like a sphere of glass heated. In like manner an indurated spheroid will exhibit the biaxal structure of a spheroid of glass.

The most splendid examples, however, of this class of facts are exhibited in the lenses of fishes and animals, as shewn in figs. 92 and 93. The first of these shews the doubly refracting structure of the crystalline lens of a cod, along the axis of vision. The central and the external luminous sectors have a *negative* doubly refracting structure, while the intermediate ones have a *positive* structure.[1]

The figure given by the crystalline lens of a cow is shewn in fig. 93, where there are *four* series of luminous sectors, the central ones being *positive*, the next *negative*, the next *positive*, and the last *negative*.[2]

CHAP. II.—ON CIRCULAR POLARISATION.

1. *Circular Polarisation in Rock-crystal and Amethyst.*

The general phenomena of circular polarisation were discovered by M. Arago in 1811. He found that in plates of rock-crystal, the colours polarised along its axis were different from those which he had studied in plates of other crystallised bodies. When they were analysed by a prism of Iceland spar, he found that the two images had complementary colours in the ordinary tints, but, what was remarkable, they descended in Newton's scale as the prism revolved, so that if the tint of the extraordinary image was *red*, it became in succession *orange*, *yellow*, *green*, and *blue*. Hence he concluded that the differently coloured rays had been polarised in different planes in passing along the axis of the rock-crystal.

M. Biot took up the subject at this point, and investigated it with his usual ingenuity and success. He found that while in *some* crystals of quartz the tints descended in the scale of colours, by turning the analysing prism from *right* to *left*, in *others* they descended in the scale by turning the prism from *left* to *right*. The one he called left-handed quartz, and the other right-handed quartz. He took a plate of quartz, for example, $\frac{1}{25}$th of an inch thick, and having polarised the homogeneous colours of the spectrum, he transmitted them in succession along the axis of this plate, and obtained the following

[1] See *Phil. Trans.*, 1816, p. 311.

[2] See *Phil. Trans.*, 1837, vol. ii.

Circular polarisation

results. When the analysing plate was in 0° of azimuth, the *red* light polarised by the plate was a maximum. When the analysing plate was turned from right to left, the *red* tint gradually diminished, and after a rotation of $17\frac{1}{2}$°, it wholly vanished. With a plate 2-25ths of an inch thick, the *red* tint did not vanish till after a rotation of 35°, and so on, every additional 25th of an inch of rock crystal requiring an additional rotation of $17\frac{1}{2}$ to make the tint vanish. A whole inch of quartz, for example, would require $25 \times 17\frac{1}{2}° = 437\frac{1}{2}°$, or one whole turn, and $77\frac{1}{2}$° more to cause the *red* tint to vanish. It is obvious that twenty-five plates of quartz, 1-25th of an inch thick, would produce the same effect as one inch of it.

When *right-handed* plates, however, are combined with *left-handed* ones, the rotation produced is equal to the difference of their actions; thus a plate of left-handed quartz 1-25th of an inch, combined with a plate 2-25ths of an inch, would produce a rotation of only $17\frac{1}{2}$°. The following table contains the rotations produced upon the other coloured rays of the spectrum, as given by M. Biot:—

Names of the ray.	Arc of rotation for 1-25th of an inch in quartz.
Extreme red,	17°·4964
Limit of red and orange,	20 ·4798
Limit of orange and yellow,	22 ·3138
Limit of yellow and green,	25 ·6752
Limit of green and blue,	30 ·0460
Limit of blue and indigo,	34 ·5717
Limit of indigo and violet,	37 ·6829
Extreme violet,	44 ·0827

M. Biot conceived that this property of quartz belonged to its ultimate molecules, but Sir David Brewster proved that this was not the case, by shewing that heat deprived quartz of the property of circular polarisation; and Sir John Herschel's beautiful discovery, that it was connected with the crystallisation of the mineral, put this result beyond a doubt. He found that those crystals in which the plagiedral faces described by Hauy, went round the crystal from *right to left*, exhibited the optical properties of left-handed crystals, and those crystals in which the plagiedral faces leant round the crystals from *left to right*, had the properties of right-handed crystals. Hence he concluded *that whatever be the cause which determined the direction of rotation, the same law acted in determining the direction of the plagiedral faces.*

When Sir David Brewster discovered the system of rings in quartz, he found the tints of circular polarisation occupying, as might have been expected, the inner circle of the rings as shewn in fig. 94, only small portions of the black cross being visible; but these black portions were larger as the plate became thinner.

Fig. 94.

Amethyst.

In examining the structure and properties of the amethyst, Sir David Brewster found that this singular mineral was actually composed of the two different kinds of quartz, viz., the *right-handed* and the *left-handed*. These two kinds of quartz are arranged in veins, as represented in figs. 95, 96. In fig. 95, the shaded veins which correspond to each alternate face of the pyramid turns the planes of polarisation from *right* to *left*, while all the rest of the crystal turns the same planes from *left* to *right;* and what is very interesting, the black lines where these two structures unite have no action whatever on the planes of polarisation. In some specimens these opposite veins are so very minute, that they destroy each other's action upon the polarised ray, and when this happens, the single system of rings appears with its black cross, and entirely free of any of the tints of circular polarisation. The colouring matter of the amethyst is arranged in a very singular manner in relation to these veins; and the fracture across the veins exhibits a beautiful, and sometimes a regular rippled structure, resembling the engine-turning of a watch, and affords an infallible mineralogical character of the amethyst, whether its colour is *yellow, orange, olive, green, blue*, or perfectly colourless.

Figs. 95, 96

Circular polarisation

Fig.

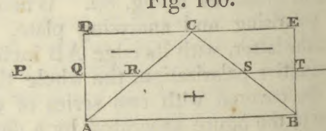
The general structure of well crystallised amethysts is shewn in fig. 96, which is of the natural size, and is taken from one of the finest specimens that Sir David Brewster met with. "On the three alternate sides of the prism," says he, "viz., MN, OP, and QR, are placed sectors M*c*N, O*d*P, Q*a*R, which are divided into two parts by dark lines *cc'*, *dd'*, *aa'*, which separate the direct structures of A, C, and E from the retrograde structures of B, D, and F. On the other three alternate faces of the prisms are placed the three veined sectors M*cba*R, N*cbd*O, and P*dba*Q, which meet at *b* in angles of 120°, and consist of veins of opposite structure, alternating with each other, and so minute, that in many places the circular tints are almost wholly extinguished by their mutual action. The direct sectors A, C, and E, are all connected together by the three radial veins *ba*, *bc*, *bd*, and are therefore to be considered as the expanded terminations of these veins. The retrograde sectors B, D, and F, are expansions of the first retrograde veins next to *bdc*, *dba*, and *abc*, and the lines *cc'*, *dd'*, and *aa'*, are continuations of the dark or neutral lines which separate the first retrograde vein from the direct radial veins.

"All the sectors A, B, C, D, E, and F, are of a *yellowish brown* colour, and all the rest of the crystal is of a *pale lilac* colour, the lilac tints being arranged in the manner previously described. The phenomena which I have now mentioned as existing in this specimen are very common in the amethyst; and I have never yet found a specimen in which the yellow tints were not confined to those portions which formed the expanded terminations of veins; a fact which indicates that this would have been the colour of the crystal, whether its action were direct or retrograde, and that the lilac colour affects in general those portions which are composed of opposite veins."

Fresnel's discoveries.

The subject of circular polarisation received great accessions from the genius of M. Fresnel. He conceived that a ray passing along the axis of quartz should be refracted in two pencils, and he ascertained this to be the case by the following experiment. He took a prism ACB of *right-handed* quartz, having its faces AC, BC, equally inclined to its axis AB, so that a ray PV should be incident at angles of 75° on either face. As a ray, however, refracted at R, would not emerge at all from the other side CB, he took another similar prism, but from a crystal of *left-handed* quartz, and having cut it into two halves, he placed these two halves ACD, BCE, as in the figure, so that he had an achromatic combination of three prisms. Now a ray PQ incident perpendicularly at Q, should pass straight on without deviation, or double refraction, if quartz were like other uniaxal crystals. But if the pencil PQ suffer any double refraction at Q, this double refraction will be doubled at R, because ABC has an opposite kind of double refraction. The same effect takes place at C, so that the ray PQ at its emergence at T, ought to have a very sensible double refraction, even if that at Q was very small. Now M. Fresnel found that this double refraction actually existed, but upon examining the image he found that they had suffered *a new kind of double refraction*, and acquired new properties. In place of their being polarised in opposite planes, like other doubly refracted pencils, which, when examined with a doubly refracting prism, give two unequal images, alternating in brightness during the revolution of the spar prism, they exhibit the following properties:—

Fig. 160.

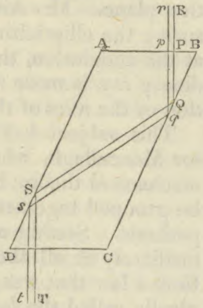


1. Either of the quartz rays, when examined with a spar prism, gave two images of equal intensity in every position

of the prism. Hence they resemble unpolarised light, as if they consisted of two rectangularly polarised rays.

2. They differ from unpolarised light in having the following remarkable and characteristic property. If either of them are incident at right angles, as shewn at RP, fig. 160, upon the face AB of a parallelopiped of crown glass, having its refracting index 1·51, and its angles ABC and ADC $54\frac{1}{2}°$, it will suffer two total reflexions at Q and S, emerging perpendicularly from the surface DC in the direction ST. Now this ray ST is found to be completely polarised in a plane inclined 45° to the plane of its reflexions, whatever may be the position of that plane. If the other ray is incident at *rp*, and is reflected at *q* and *s*, so as to emerge in the direction *st*, the one ray ST will be polarised in a plane 45° to the *right*, and the other *st* 45° to the *left* of the plane of reflexion. Hence they emerge when superimposed in a state of common light. The two rays RP, *rp*, are said to be *circularly polarised*.

Fig. 161.



3. If a ray thus circularly polarised is transmitted through a thin crystallized plate, and parallel to its axis, it is divided by double refraction into two rays of complementary tints, thus shewing a decided difference from a ray of common light; and these complementary colours always differ from those that are produced from light, polarised and analysed in the usual way, by an exact quarter of a tint either in defect or in excess.

4. A circularly polarised ray transmitted again along the axis of rock crystal, and subsequently analysed, produces, like common light, no colours, and differs in this respect from polarised light.

As two circularly polarised rays RP, *rp*, emerge from *Fresnel's rhomb*, (as the parallelopiped of glass ABCD, fig. 160, has been called), in rays ST, *st*, polarised $\pm 45°$ to the plane of reflection, it occurred to Fresnel, and he found it to be so, that a ray TS polarised 45° to the plane of reflexion in the rhomb, would emerge in the direction PR, as a circularly polarised ray, possessing all the properties of one of the rays formed along the axis of quartz.

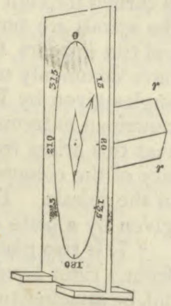
In an extensive series of experiments, of which we shall give some account in the following chapter, Sir David Brewster had occasion to examine some of the kindred phenomena of circular polarisation. His first experiments on this subject preceded those of Fresnel. He found that total reflexion produced polarised tints analogous to those of crystallised laminæ, and he supposed that these colours were produced by the interference of two portions of light, the one partially reflected in the first instance, and the other beginning to be refracted, and caused to return, by the continued operation of the same power.[1] In continuing his experiments, he found that the colours produced by total reflexion did not rise in the scale by successive reflexions; and at the end of 1816, he announced in the *Journal* of the Royal Institution,[2] that he had discovered "a new species of moveable polarisation, in which the complementary tints never rise above the white (the bluish white) of the first order, by the successive application of the polarising influence," &c. He determined experimentally the angles at which this tint was successively produced and destroyed, and thus discovered some of the leading properties of total reflexion. It was Fresnel, however, that discovered this new species of polarisation to be circular, and made those other splendid discoveries which we have just detailed. We owe to Sir David Brewster, however, the discovery of the inversion of the spectrum in the phenomena of total reflexion, of which we shall give some account in the next chapter.

Circular polarisation.

Discovery of Mr. Airy.

In giving the name of circular polarisation to that which is impressed on the two rays along the axis of quartz, M. Fresnel was guided by theoretical considerations. Mr. Airy has, however, taken a different view of the condition of the light forming these two rays in quartz, and has been led to results of very high interest. The following are the experiments, which we shall give in his own words, on which he founded his deductions. They were made with a Fresnel's rhomb, fitted up as in the annexed figure, where the rhomb is shewn at *rr*.

Fig. 162.



"1. If Fresnel's rhomb, mounted as in the annexed figure, be placed to receive the polarised light, so that the plane of reflexion passes through the divisions 45° and 225°, the calc spar will present another appearance 97. The rings are abruptly and absolutely dislocated: those in the upper right hand quadrant and the quadrant opposite to it, are pushed from the centre by one-fourth of an interval, and those in the other quadrants are drawn nearer to the centre by the same quality. The line separating the quadrants is nowhere black; the intensity of its light is uniform, and about equal to the mean intensity. If the plane of incidence pass through 135° and 315°, the phenomena of adjacent quadrants are exactly interchanged. No alteration is made by turning the analysing plate round the incident ray; the lines dividing the quadrants are always parallel and perpendicular to the plane of reflexion at the analysing plate. Fig. 97.

"2. If the plane of reflexion in the rhomb pass through 0° and 180°, or through 90° and 360°, the phenomena are precisely the same, and undergo the same changes as those in ordinary rings. If while the plates are crossed, the rhomb be turned gradually from the position 0° towards 45°, the rings are gradually changed, at first becoming (as far as the eye can judge) elliptical, and then assuming the form represented in fig. 98. Fig. 98.

"3. If a plate of quartz, whether right or left handed, be interposed between the crossed plates, a set of rings is seen like those in fig. 94. As far as the eye can judge, the rings are exactly circular, but there is no black cross, and the central tint is not black, but removed from it by a number of tints in Newton's scale proportional to the thickness of the quartz. Thus with a thickness of 0·48 inch, the central tint is pale pink; with a thickness 0·38 inch, the central tint is bright yellowish green; with thickness 0·26 inch it is a rich red plum colour; with thickness 0·17 inch, it is a rich yellow. Fig. 94.

"The colours then appear to be nearly the same, beginning from the centre, as in Newton's scale, beginning with the tint representing this central tint. At a considerable distance from the centre, four dark brushes begin to be visible, in the same directions as the arms of the black cross in calc spar.

"4. Now, (supposing the crystal right handed), if the plate of quartz be thin, and the analysing plate be turned, the upper part towards the observer's left hand, a bluish short-armed cross appears in the centre, which, on turning further, becomes yellow, and the rings are enlarged. On turning still further, the cross breaks into four dots. The rings are no longer circular, but of a form intermediate between a circle and a square, their diagonals (as well as the cross) being inclined to the left of the parallel, and perpendicular to the plane of reflexion. See fig. 99. If the analysing plate be turned the other way, there is no cross; the form of the rings is changed from circular nearly as in the former case. Fig. 99.

"5. If the plate of quartz be thick, the dilatation, and the rings, and the change of form are all the perceptible phe-

[1] See Chromatics, vol. vi. p. 646, and *Phil. Trans.* 1830, p. 310.

[2] Vol. iii. p. 213.

Circular polarisation

nomena. And on turning the analysing plate continually to the left, the rings continually dilate, and new spots start up continually in the centre, and become rings. If the crystal be left handed, the remarks in this and the last article apply equally well, supposing the analysing plate turned in the opposite direction.

"6. If Fresnel's rhomb be placed in the position 45°, and the light thus circularly polarised pass through the quartz, on applying the analysing plate instead of rings, there are seen two spirals naturally inwrapping each other, as in fig. 100. If the rhomb be placed in position 135°, the figure is turned through a quadrant. If the quartz be left handed, the spirals are turned in the opposite direction. The central tint appears to be white. With the rhomb which I have commonly used, (which is of plate glass, but with the angles given by Fresnel for crown glass), there is at the centre an extremely dilute tint of pink. I think it likely that this arises from the cross in the angles, as the intensity of the colours have no proportion to that in other parts of the spirals. The figure was drawn from the appearances given by a plate of quartz 0·26 inch thick.

Fig. 100.

"7. If two plates of quartz of equal thickness, but cut one from a right handed, and the other from a left handed crystal, be attached together, and put between the polarising and analysing plates, the left handed slice nearest to the polarising plate, the appearance presented is that of fig. 101. Four spirals (proceeding from a black cross in the centre, which is inclined to the plane of reflexion), cut a series of circles at every quadrant. The points of intersection are in the plane of reflexion, and perpendicular to it. This is the simplest way of describing the form; but if we followed the colours which graduate most gently, we should say that the form of each is alternately a spiral and circular arc, quadrant after quadrant.

Fig. 101.

"At a distance from the centre, the black brushes are seen. If the combination be turned, so that the right handed slice is nearest to the polarising plate, the spirals are turned in the opposite direction. This is one of the most beautiful phenomena of optics. The slices from whose appearance the figure was drawn, are each 0·16 inch thick."

The preceding phenomena are described as they appear when examined with an analysing plate of unsilvered glass. The following are the theoretical views which Mr. Airy considers as consonant with these experiments. They had been originally suggested to him by the desire of finding some connecting link between the peculiar double refraction in quartz, and the common double refraction.

"1. I suppose the ordinary rays to consist of light elliptically polarised, the greater axis of the ellipse being perpendicular to the principal plane, and the extraordinary rays to consist of light elliptically polarised, the greater axis of the ellipse being in the principal plane.

"2. I suppose that when the ordinary ray is right-elliptically polarised, the extraordinary ray is left-elliptically-polarised, and *vice versâ*.

"3. I suppose that the proportions of the axes of the two ellipses are the same, each proportion being one of equality when the direction of the ray coincides with the axis, and becoming more unequal, according to some unknown law, as the direction is more inclined to the axis; the minor axes of the ellipses having sensible magnitudes when the rays are inclined 10° to the axis.

"4. I suppose that the course of the rays after refraction can be determined by the construction given by Huygens for calc spar, with this difference only, that the prolate spheroid for determining the course of the extraordinary ray must not be supposed to touch the sphere for determining the course of the ordinary ray, but must be entirely contained within it."

Circular polarisation

In a supplement to his investigations, Mr. Airy remarks, that he has not yet ascertained the law which connects the ellipticity of the rays with the angle that they make with the axis. He considers, however, the following points as made out:—

"One of the rays is certainly right-handed elliptical, and the other certainly left-handed elliptical. The major axis of one is certainly perpendicular to the principal plane of the crystal, and the major axis of the other is certainly in that plane. Mr. Airy remarks, that in some trials for measuring the ellipticities of the rays, he seems to have arrived at the conclusion, that the proportion of the axes of the ordinary ray is more nearly one of equality than the proportion of the axes of the extraordinary ray."

Professor Maccullagh.

This subject has recently been investigated by Professor Maccullagh, whose object was to pave the way for a mechanical theory, by shewing that all the phenomena may be grouped together by means of a simple geometrical hypothesis. Setting out from this hypothesis, he arrives immediately at all the known laws, and obtains at the same time a law that was previously unknown, and which is technically called the *law of ellipticity*. By this law Professor Maccullagh has been able to compute the ellipticities observed by Mr. Airy in rays inclined to the axis of quartz, from the angles of rotation observed by M. Biot in rays parallel to that axis.[1]

The phenomena of circular polarisation were discovered by Sir David Brewster, in plates of glass possessing the doubly refracting structure. M. Dove of Berlin has found it also in compressed glass and has published an interesting memoir on the subject, in which he takes little notice of the previous labours of others, on the various subjects of which he treats. As our limits will not permit us to give any account of its contents, we must refer our readers to the original memoir.[2]

Sect. I.—*On the Circular Polarisation of Fluids.*

Although this remarkable property was discovered in some fluids by M. Seebeck by independent observation, yet M. Biot had anticipated him in it, and has made this subject so completely his own, by a series of the most elaborate and beautiful researches, that if he had done nothing else for science, they would have ensured him a high reputation. We regret extremely that our limits will not permit us to give any thing like a full and satisfactory account of his discoveries, particularly those contained in his valuable paper of 1832. We must therefore refer the reader to his original memoirs, and present to them in as abridged a form as possible his leading results.

M. Biot discovered that some fluids turn the planes of a polarised ray from right to left, and others from left to right. He found also that the tints rose in the scale as in quartz by an increase in the thickness of the fluid. The following table contains some of his results:—

I. *Fluids that turn the Plane of Polarisation from Left to Right.*

	Colours.	Arcs of rotation with the red rays, with a thickness of 200 millimetres.
Oil of fennel seeds	Palish green	26°·32
—— carraway seeds	Colourless	131 ·58
—— lavender	Greenish	4 ·04
—— rosemary		6 ·58
—— marjoram	Orange yellow	23 ·68
—— sassafras	Yellow	7 ·06
—— savine	Yellow	14 ·12
—— bitter oranges	Greenish yellow	157 ·89
—— bergamot	Colourless	38 ·16
—— lemons	Colourless	110 ·53
Neroli, common	Yellow	$\frac{7}{12}$ths of oil of oranges.
—— fine	Orange yellow	Do.
—— superfine	Reddish or.	$\frac{5}{28}$ths of com. Neroli.

[1] Report of the British Association for 1836, p. 18.

[2] This memoir has been translated and published in Taylor's Scientific Memoirs, vol. i. part i. p. 75.

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II. *Fluids that turn the Plane of Polarisation from Right to Left.*

Essential oil of turpentine	Greenish	59°·21
Naphtha	Greenish	15 ·21
Oil of anise seeds	Greenish	1 ·51
—— mint	Limpid	32 ·28
—— rhue	Yellowish	conjectured.

Oil of mustard and oil of *bitter almonds* exercise no action upon polarised light.

Camphor.

M. Biot found that in a solution of *natural camphor* in alcohol, in which there was 0·37117 of camphor in weight to I of the solution, and its density 0·87221, the rotation for *red* light, and a thickness of 152 millimetres, was 17° ·56 from *left to right.* A solution of *artificial camphor* in alcohol, on the other hand, with 0·0917 of camphor to of the solution, and having its density 0·8455, and in a thickness of 1357 millimetres, produced only a rotation of 24°, but in the opposite direction, from *right to left.* In *gum from Senegal,* of which 47·4 parts was dissolved in 99·1 of distilled water there was a rotation from right to left, of 12° 13′ 20″, with a thickness of 152 millimetres.

The following table contains the results which our author obtained from different kinds of sugar :—

From Left to Right.

	Proportion of sugar in 1 of the solution.	Density.	Arc of rotation of red light in a thickness of 152 millimeters.	Molecular power of rotation.
Sugar of canes, syrup of..	0·25	1·1052	23° 28 45	83° 94
——————	0·50	1·2311	52 7 30	
——————	0·65	1·3114	70 11 15	
Sugar of milk	0·14	1·0537	10 21 40	70·18
——Starch	0·65	1·2460	48 30 0	59·99
Crystallisable principle of honey	0·34	1·1329	16 47 30	43·32
Sugar of grapes				59·10

From right to left.

The rotation being observed for the yellow rays, and the thickness of solution 152 millimeters as before.

Sugar of grapes in syrup	10° 0′ 0″
Uncrystallisable principle of honey, alcoholic solution	3 38 20
——————the same dry	11 15 0

M. Biot made experiments with various vegetable juices, all of which gave a slight rotation from *right to left.*

	Thickness of fluid.	Rotation.
Juice of grapes white	160 millimetres	6°
Do. red and white mixed	160 ————	6·25
Chasselas	160 ————	5·50
Muscat	160 ————	5·33
Verjuice	160 ————	1·81
Chasselas of Fountainbleau	160 ————	8·00
Common black grape	160 ————	10·00
Apples for cider	————	3·33
Red gooseberries very ripe	80 ————	1·81
Berries of the service tree	160 ————	2·5

M. Biot also found, that claret, white champagne, alcohol, sulphuric ether, citric acid dissolved in the proportion of 30 to 37 of water, sulphuric acid pure and colourless, and olive oil, produced no effect upon polarised light.

He found, however, that tartaric acid dissolved in the proportion of 53 of acid to 52 of water produced a rotation of 8° *from right to left.*

Dextrine.

One of the most curious discoveries contained in M. Biot's memoir, is that of the powerful rotatory property of *dextrine* an uncrystallisable syrup which is found in the farina of rice, wheat, and even of ligneous tissue.[1] It differs from gum in producing an opposite rotation, and from sugar in its superior power of rotation, which is almost triple of that which is exerted by sugar of canes. It surpasses all animal and vegetable substances at present known, at equal densities and thicknesses, in turning round the plane of a polarised ray,—rock crystal only being superior to it. The name of dextrine has been given to it in order to mark the direction as well as the powerful energy of its force of rotation.

M. Biot and M. Persoz have more recently found a sugar of starch, whose power of rotation is almost equal to that of crystallised sugar of canes. They have also discovered that, when sugar of canes is dissolved in water mixed with dilute sulphuric acid, and heated below the boiling point, it loses its power of turning the planes of polarisation from left to right, like sugar of grapes not solidified. Sugar of starch submitted to the same process did not experience this inversion.

M. Biot likewise found, that the colouration of liquids did not exercise any influence on their rotatory property.

We regret that want of room prevents us from giving any account of M. Biot's more recent, and extremely interesting researches on the growth and nutrition of plants. These researches have a high practical value, and shew in a striking manner that the most abstract researches in physical science will sooner or later find some useful application.

Elliptical polarisation

CHAP. III.—ON ELLIPTICAL POLARISATION.

The phenomena and laws of elliptical polarisation, as they are at present known, have been investigated only by Sir David Brewster. This species of polarisation forms the connecting link between *plane polarisation* and *circular polarisation,* passing nearly into the former when exhibited by *galæna* and into the latter when exhibited by *silver.*

Sir David Brewster found at an early period, what Malus had previously observed, that the light reflected from metals was polarised in different planes. The former, however, found, that the pencil polarised in the plane of reflexion was always more intense than that polarised in a perpendicular plane, and which he conceived had entered the metal and been partially absorbed. He found the difference between the intensities of these pencils to be least in silver and greatest in galæna, metals which had an intermediate effect, being arranged as in the following table.

Order in which the metals polarise most light in the plane of reflexion.

Galæna.	Steel.	Copper.	Fine gold.
Lead.	Zinc.	Tin plate.	Common silver.
Grey cobalt.	Speculum metal.	Brass.	Pure silver.
Arsenical cobalt.	Platinum.	Grain tin.	Total reflexion from glass.
Iron pyrites.	Bismuth.	Jewellers' gold.	
Antimony.	Mercury.		

He found also that, by increasing the number of reflexions, *the whole of the light could be polarised in one plane.* The white light of a wax candle 10 feet distant, is polarised by *eight* reflexions from *steel* between 60° and 80°, whereas it requires more than *thirty-six* from *silver,* and in total reflexion where the elliptical polarisation becomes circular; and when the two pencils are equal, the total polarisation of the pencil cannot be effected by any number of reflexions.

The action of metals upon polarised light presents us with a series of very extraordinary phenomena. One of the first of these which was discovered by our author, was the action of successive reflections from silver and gold upon polarised light. These reflexions are made from two metallic plates placed between the polarising and analysing plate or rhomb, and when the plane of metallic reflexions is parallel or perpendicular to the plane of primitive polarisation, its

[1] Dextrine may be procured from laundry starch by hot or cold acids, by potash, or by hot water, any one of which will rupture the envelope and set free the dextrine.

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azimuth will be 0°, 90°, 180°, &c. and when it is inclined 45° to that plane, its azimuth will be 45°, 135°, &c.

In azimuth 0° no colours are observed by reflexions from two plates of silver placed parallel to one another, just as in the case of crystallised laminæ whose axes are in 0° of azimuth.

At 45°, 135° of azimuth, the most brilliant complementary colours are seen, either by turning round the analysing plate, or by using a rhomb of spar that gives two images. These colours become fainter and fainter while the azimuth changes from 45° to 90°, or from 45° back to 0°, exactly like those of crystallised laminæ.

When a small number of reflexions are used, the tints are fainter and less brilliant, and they increase with the number of reflexions. There is an angle of reflexion about 75°, at which the tints are brightest, and they become fainter as the reflexions are performed at greater or at less angles.

All the other metals in the preceding table, as well as total reflexion from glass, give analogous colours, but they are most brilliant in silver, and diminish towards galæna.

Now, it is obvious, that at about 75° of incidence (if we suppose the metal to be steel) the polarised light which it reflects has acquired some new physical property.

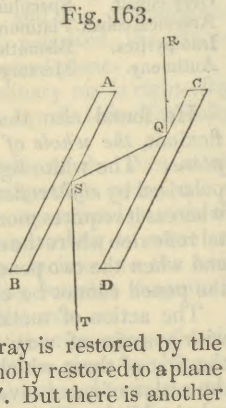
1. It is neither *common light* nor *partially polarised* light, because if we reflect it a second time at 75° *it is restored* to light polarised in one plane.

2. It is not polarised light, because it does not vanish during the revolution of the analysing rhomb.

In order then to discover its nature, let it be transmitted along the axis of Iceland spar. The common uniaxal system of rings is changed into that shewn in fig. 102, which is similar to the effect produced by crossing the uniaxal system of rings with a thin film polarising the pale blue of the first order. If we substitute for the Iceland spar, films of sulphate of lime, we shall find that their tints are increased or diminished according as the metallic action coincides with or opposes that of the crystal. This experiment led our author into the erroneous opinion that metals acted like crystallised plates; but when he found that a second reflexion at 75° destroyed the effect of the first reflexion, he saw that this opinion was untenable, and was led to consider the phenomena as having some resemblance to those of circular polarisation.

We have already seen, that a circularly polarised ray RP, fig. 161, emerges after two total reflexions in the direction ST, polarised 45° to the plane of the two reflexions in every azimuth. Now, if we reflect a ray of light R polarised +45° at Q from one plate of *silver* CD, the rays QS will have acquired a property analogous to that of circular polarisation; for if it is reflected a second time at S, the reflected ray ST will emerge polarised 39° 48′ to the plane of reflexion. Now the difference between this result and that from total reflexion, is that one reflexion from silver impresses the same character upon light, whereas in total reflexion two reflexions are necessary. Another point of difference is, that when the ray is restored by the same number of reflexions, it is not wholly restored to a plane — 45°, but only to a plane — 39° 48′. But there is another difference of a very interesting kind. In circular polarisation, the ray has the same properties on all its sides, and the angles of reflexion at which it is restored to polarised light in different azimuths, are all equal to the radii of a circle described round the rays. "Hence," says our

Fig. 163.



Elliptical polarisation

author, "without any theoretical reference the term *circular polarisation* is from this and other facts experimentally appropriate.[1] In like manner, *without referring to the theoretical existence of elliptical vibrations* produced by the interference of two rectilineal vibrations of unequal amplitudes, we may give to the new phenomenon the name of *elliptic polarisation*, because the angles of reflexion at which this kind of light is restored to polarised light, may be represented by the variable radius of an ellipse."

Now, it is a curious fact, that while silver restores the ray to angles of 39° 48′, other metals restore it to angles deviating more and more from 45°, as is shewn in the following table:

	Inclination of restored ray.		Inclination of restored ray.
Total reflexion from glass	45° 0′	Bismuth	21° 0′
Pure silver	39 48	Speculum metal	21 0
Common silver	36 0	Zinc	19 10
Fine gold	35 0	Steel	17 0
Jewellers' gold	33 0	Iron pyrites	14 0
Grain tin	33 0	Antimony	16 15
Brass	32 0	Arsenical cobalt	13 0
Tin plate	31 0	Cobalt	12 30
Copper	29 0	Lead	11 0
Mercury	26 0	Galæna	2 0
Platina	22 0	Specular iron	0 0

Hence it appears that the elliptic polarisation passes into circular nearly in the case of *silver*, and into plane polarisation in the case of *galæna;* the ellipsis becoming nearly a *circle* in the former case, and a *straight* line in the latter.

As light polarised + 45° suffers different degrees of elliptical polarisation by one reflexion from metals, and is restored again to polarised light, though in different planes, by a second reflexion, so it exhibits the same phenomena at 3, 5, 7, 9 in reflexions, and is restored to polarised light by 4, 6, 8, 10 reflexions at the same angle. The following table shews the inclination of the plane of polarisation of the restored ray to the plane of reflexion, in various numbers of reflexions from silver and steel.

Number of Reflexions.	Inclination of the plane of the polarised ray. Steel.	Silver.
2	— 17° 0′	— 38° 15′
4	+ 5 22	+ 31 52
6	— 1 38	— 26 6
8	+ 0 30	+ 21 7
10	— 0 9	— 16 56
12	+ 0 3	+ 13 30
18	— 0 0	— 6 42
36	0 0	+ 0 47

These results shew in the clearest manner the reason why common light is polarised by 8 reflexions from *steel*, and not till after 36 reflexions from silver, the planes of inclination of the two rectangularly polarised rays requiring in each case that number of reflexions to bring them into a state of parallelism.

The angles at which elliptical polarisation is produced by one reflexion, may be regarded in the present state of our knowledge of the subject as the angle of maximum polarisation, and its tangent as the index of refraction of the metal, as given in the following table:

Name of metal.	Angles of maximum polarisation.	Index of refraction.
Grain tin	78° 30′	4·915
Mercury	78 27	4·893
Galæna	78 10	4·773
Iron pyrites	77 30	4·511
Grey cobalt	76 56	4·309
Speculum metal	76 0	4·011
Antimony melted	75 25	3·844
Steel	75 0	3·732
Bismuth	74 50	3·689
Pure silver	73 0	3.271
Zinc	72 30	3·172
Tin plate hammered	70 50	2·879
Jewellers' gold	70 45	2·864

1 See Sir John Herschel's *Treatise on Light*, § 1050.

Elliptical polarisation.

We may produce elliptical polarisation by a sufficient number of reflexions at any given angle, in the same manner as in plane polarisation. The following table contains the results of observations made with *steel:*

Number of reflexions at which elliptical polarisation is produced.	Number of reflexions at which the pencil is restored to a single plane.	Observed angle of incidence.
3 9 15, &c.	6 12 18, &c.	86° 0′
$2\frac{1}{2}$ $7\frac{1}{2}$ $12\frac{1}{2}$, &c.	5 10 15, &c.	84 0
2 6 10, &c.	4 8 12, &c.	82 20
$1\frac{1}{2}$ $4\frac{1}{2}$ $7\frac{1}{2}$, &c.	3 6 9, &c.	79 0
1 3 5. &c.	2 4 6, &c.	75 0
$1\frac{1}{2}$ $4\frac{1}{2}$ $7\frac{1}{2}$, &c.	3 6 9, &c.	67 40
2 6 10, &c.	4 8 12, &c.	60 20
$2\frac{1}{2}$ $7\frac{1}{2}$ $12\frac{1}{2}$, &c.	5 10 15, &c.	56 25
3 9 15, &c.	6 12 18, &c.	52 20

At an incidence of 67° 40′ elliptical polarisation is produced by $1\frac{1}{2}$, $4\frac{1}{2}$, $7\frac{1}{2}$ reflexions. Hence we draw the interesting conclusion, that the ray must have completed its elliptical polarisation in the middle of the *second* and *fifth* reflexion; that is, when it had reached its greatest depth within the metallic surface. It then begins to resume its state of polarisation in a single plane, and recovers it at the end of the 3d, 5th, and 7th reflexion. Another very interesting effect is produced when one reflexion is made on one side of the polarising angle, and the other reflexion on the other side. A ray that has been partially elliptically polarised by one reflexion at 85° does not as in plane polarisation acquire more by a reflexion at 54°, but it retraces its course, and recovers its state of single polarisation.

We have seen that by *two* reflexions, there is only *one* angle, viz. 73° for silver, at which the elliptically polarised ray can be restored to plane polarisation. At *three* reflexions there are *two* angles, viz. 63° 43′, and 79° 40′, at which the restoration can take place, at *four* reflexions *three* angles, and so on. This phenomena is exhibited to the eye in fig. 103, where the concentric arches I, I; II, II, &c., represent the quadrant of incidence from *one, two*, &c. reflexions, B being the point of 90° and C that of 0°. The point D on the line A is the point or line of maximum elliptic polarisation, viz. 73° for silver, and the figures 1, 2, 3, 4, 5, indicate the points or nodes of restoration, and their distances from C, the corresponding angles of incidence at which the restoration takes place. The loops or double curves lying between the points 1, 2, 3, &c. are drawn to give an idea of the intensity of the elliptic polarisation which has its minimum at 1, 2, 3, &c. and its maximum at the white intermediate parts. These points of maximum intensity do not bisect the loops, or are not equidistant from the minima; but such is their relation that the *maximum* for n reflexions is the minimum for $2n$ reflexions. These phenomena lead us to the explanation and analysis of the complementary colours which accompany elliptical and circular polarisation.

Fig. 103.

On the Colours of Elliptical and Circular Polarisation.

When the preceding experiments are made with homogeneous light, we find that the points and angles of restoration vary for the differently coloured rays. Thus in *silver* we have the maximum polarising angle as follows:

		Corresponding index of refraction.
For red light	$75\frac{1}{2}$	3·866
For yellow light	73	3·271
For blue light	$70\frac{1}{2}$	2·824

Hence it is obvious that at the point of restoration where the *blue* rays are restored, and vanish, the *red* rays are not restored, and consequently will appear when the principal section of the analysing rhomb is in the plane of reflexion. Here, then, we have the cause of the phenomena of the complementary colours seen in reflexion from metals. They are analogous to the colours in *oil of cassia*, and *chromate of lead* at the maximum polarising angle.[1]

Elliptical polarisation

Fig. 103.

But the remarkable result of the preceding measures is, that in *metallic* as well as in *total reflexion*, the *index of refraction is less for blue than for red light*, or in the language of the undulatory theory, the refractive index increases with the length of the wave. In a recent communication to the Royal Irish Academy,[2] on the propagation of light in uncrystallized media, Professor Lloyd has obtained an expression for the velocity of the propagation of light, each of its terms consisting of two parts with opposite signs, one of which is due to the action of the ether and the other to that of the body. Conceiving, therefore, that there may be bodies in which the principal term is nearly nothing, the principal part of the expression will be that derived from the second term; and if that term be taken as an approximate value, it will follow that the refractive index of the substance must be in the subduplicate ratio of the length of the wave nearly. "Now," says Professor Lloyd, "it is remarkable that this law of dispersion, so unlike any thing observed in transparent media, agrees pretty nearly with the results obtained by Sir David Brewster in some of the metals. In all these bodies, the refractive index (inferred from the angle of maximum polarisation) increases with the length of the wave. Its values for the *red, mean*, and *blue*, ray in *silver*, are 3·866, 3·271, 2·824, the ratios of the second and third to the first being .85 and .73. According to the law above given, these ratios should be .88 and .79."

Professor Maccullagh has very recently[3] endeavoured to represent the phenomena described in the preceding pages by empirical formulæ, in the same manner as Fresnel represented those of total reflexion. The following is a brief abstract of Professor Maccullagh's researches, which we shall give in his own words.

"The author observes, that the theory of the action of metals upon light is among the *desiderata* of physical optics, whatever information we possess upon this subject being derived from the experiments of Sir David Brewster. But, in the absence of a real theory, it is important that we should be able to represent the phenomena by means of empirical formulæ; and accordingly, the author has endeavoured to obtain such formulæ by a method analogous to that which Fresnel employed in the case of total reflexion at the surface of a rarer medium, and which, as is well known, depends on a peculiar interpretation of the sign $\sqrt{-1}$. For the case of metallic reflexion, the author assumes that the velocity of propagation in the metal, or the reciprocal of the refractive index, is of the form

$$m\,(\cos.\chi + \sqrt{-1}\,\sin.\chi)\,;$$

without attaching to this form any physical signification, but using it rather as a means of introducing two constants (for there must be two constants, m and χ, for each metal) into Fresnel's formulæ for ordinary reflexion, which contain only one constant, namely, the refractive index.

"Then if i be the angle of incidence on the metal, and i' the angle of refraction, we have

$$\sin.\,i' = m\,(\cos.\chi + \sqrt{-1}\,\sin.\chi)\,\sin.\,i, \qquad (1)$$

and therefore we may put

$$\cos.\,i' = m'\,(\cos.\chi' - \sqrt{-1}\,\sin.\chi')\,\cos.\,i, \qquad (2)$$

if $$m'^4\cos.^4 i = 1 - 2\,m^2\cos.\,2\chi\,\sin.^2 i + m^4\sin.^4 i, \qquad (3)$$

and $$\tan.\,2\chi' = \frac{m^2\sin.\,2\chi\,\sin.^2 i}{1 - m^2\cos.\,2\chi\,\sin.^2 i}. \qquad (4)$$

"Now, first, if the incident light be polarised in the plane

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[1] For a full analysis of these phenomena, see *Phil. Trans.* for 1830, p. 319.

[2] Jan. 9, 1837.

[3] Proceedings of Royal Irish Academy, Oct. 24, 1836.

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of reflexion, and if the preceding values of sin. i', cos. i', be substituted in Fresnel's expression

$$\frac{\sin.\ (i-i'}{\sin.\ (i+i')},$$

for the amplitude of the reflected vibration, the result may be reduced to the form

$$a\ (\cos.\ \delta - \sqrt{-1}\ \sin.\ \delta), \tag{5}$$

if we put

$$\tan\psi = \frac{m}{m'}, \tag{6}$$

$$\tan \delta = \tan 2\psi \sin (\chi + \chi') \tag{7}$$

$$a^2 = \frac{1 - \sin 2\psi \cos (\chi + \chi')}{1 + \sin 2\psi \cos (\chi + \chi')}. \tag{8}$$

Then according to the interpretation, before alluded to, of $\sqrt{-1}$, the angle δ will denote the *change of phase*, or the retardation of the reflected light; and a will be the amplitude of the reflected vibration, that of the incident vibration being unity. The values of m', χ', for any angle of incidence, are found by formulæ (3), (4), the quantities m, χ, being given for each metal. The angle χ' is very small, and may in general be neglected.

"Secondly, when the incident light is polarised perpendicularly to the plane of reflexion, the expression

$$\frac{\tan (i - i')}{\tan (i + i)}$$

treated in the same manner, will become

$$a'(\cos \delta' - \sqrt{-1} \sin \delta') \tag{9}$$

if we make

$$\tan \psi' = mm', \tag{10}$$

$$\tan \delta' = \tan 2\psi' \sin (\chi - \chi'), \tag{11}$$

$$a'^2 = \frac{1 - \sin 2\psi' \cos (\chi - \chi')}{1 + \sin 2\psi' \cos (\chi - \chi')}; \tag{12}$$

and here, as before, δ' will be the retardation of the reflected light, and a' the amplitude of its vibration.

"The number $\text{M} = \frac{1}{m}$ may be called the *modulus*, and the angle χ the *characteristic* of the metal. The modulus is something less than the tangent of the angle which Sir David Brewster has called the *maximum polarising angle.* After two reflections at this angle, a ray originally polarised in a plane inclined 45° to that of reflexion, will again be plane polarised in a plane inclined at a certain angle ϕ (which is 17° for steel) to the plane of reflexion; and we must have

$$\tan \phi = \frac{a'^2}{a^2} \tag{13}$$

Also, at the maximum polarising angle we must have

$$\delta' - \delta = 90° \tag{14}$$

And these two conditions will enable us to determine the constants M and χ for any metal, when we know its maximum polarising angle and the value of ϕ; both of which have been found for a great number of metals by Sir David Brewster. The following table is computed for steel, taking $\text{M} = 3\frac{1}{2}$, $\chi = 54°$.

	δ	δ	a^2	a'^2	$\frac{1}{2}(a^2 + a'^2)$
0°	27°	27°	·526	·526	·526
30	23	31	·575	·475	.525
45	19	38	·638	·407	·522
60	13	54	·729	·308	·518
75	7	98	·850	·240	·545
85	2	152	·947	·491	·719
90	0	180	1·	1·	1·

"The most remarkable thing in this table is the last column, which gives the intensity of the light reflected when common light is incident. The intensity *decreases* very slowly up to a large angle of incidence, (less than 75°,) and then increases up to 90°, where there is total reflexion. This singular fact, that the intensity decreases with the obliquity of incidence, was discovered by Mr. Potter,[1] whose experiments extend as far as an incidence of 70°. Whether the subsequent increase which appears from the table indicates a real phenomenon, or arises from an error in the empirical formulæ, cannot be determined without more experiments. It should be observed, however, that in these very oblique incidences Fresnel's formulæ for transparent media do not represent the actual phenomena for such media, a great quantity of the light being stopped, when the formulæ give a reflexion, very nearly total.

"The value of $\delta' - \delta$, or the difference of phase, increases from 0° to 180°. When a plane-polarised ray is twice reflected from a metal, it will still be plane-polarized if the sum of the values of $\delta' - \delta$ for the two angles of incidence be equal to 180°.

"It appears from the formulæ, that when the characteristic χ is very small, the value of δ' will continue very small up to the neighbourhood of the polarising angle. It will pass through 90°, when $mm' = 1$; after which the change will be very rapid, and the value of δ' will soon rise to nearly 180°. This is exactly the phenomenon which Mr. Airy observed in the diamond.

"Another set of phenomena to which the author has applied his formulæ are those of the coloured rings formed between a glass lens and a metallic reflector; and he has thus been enabled to account for the singular appearances described by M. Arago in the *Memoires d'Arcueil*, tom. 3, particularly the succession of changes which are observed when common light is incident, the intrusion of a new ring, &c. But there is one curious appearance which he does not find described by any former author. It is this. Through the last twenty or thirty degrees of incidence the first dark ring, surrounding the central spot, which is comparatively bright, remains constantly of the same magnitude; although the other rings, like Newton's rings formed between two glass lenses, dilate greatly with the obliquity of incidence. This appearance was observed at the same time by Professor Lloyd. The explanation is easy. It depends simply on this circumstance, (which is evident from the table,) that the angle $180° - \delta'$, at these oblique incidences, is nearly proportional to cos. i.

"As to the index of refraction in metals, the author conjectures that it is equal to $\frac{\text{M}}{\cos \chi}$."

Undulatory theory.

In concluding our account of the phenomena of Physical Optics, we could have wished to have given a popular account of the undulatory theory of light, and of the explanation which it affords of a great variety of the most interesting phenomena in optics. This however has been done to such an extent by Dr. Thomas Young, in the article Chromatics in this work, and in the article Polarisation by M. Arago, that we would not be justified in entering again upon the subject. Notwithstanding, however, its acknowledged power in accounting for such a variety of facts, there are many of the principal phenomena in optics of which it is not capable of giving the least explanation; and there are others to which it seems in its present form to be totally inapplicable. We look forward, however, with much hope, to the labours of Professor Lloyd, and Professor Maccullagh, and Professor Powell, in this country, who, in place of checking the progress of enquiry, as has been lately done, by declaring the theory of undulations to be

[1] See *Edinburgh Journal of Science, N. S.* Oct. 1830, vol. iii. p. 278.

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already capable of explaining every phenomenon, regard it as still imperfect even as a mathematical representation of the phenomena, and consider experimental research as the only means by which a true theory of light can be obtained.

PART VIII. ON THE APPLICATION OF OPTICS TO THE EXPLANATION OF NATURAL PHENOMENA.

As several of the subjects which belong to this branch of Optics have been treated pretty fully in other parts of this work, we must confine our attention to topics which have not been previously discussed.

Sect. I.—*On the Rainbow.*

Rainbow.

Fig. 104.

A general description of the rainbow has already been given among the optical phenomena in Meteorology. In order to explain the progress of the rays of light which form the two bows, let R, R, R, R, fig. 104, be parallel rays proceeding from the sun, situated at the back of the observer, placed at O, and let them fall on drops of rain E, F, G, H, in front of the observer. Some of these rays of light will enter the spherical drops of rain, and those which fall perpendicularly and nearly so, will be transmitted through the drop, and of course never reach the observer at O. Other rays, however, especially those which fall obliquely, will be separated into the prismatic colours at the first refraction, and will subsequently be reflected *once*, *twice*, and more times, within the drop, and emerge after *one*, *two*, or more reflexions in different directions. Now, it is obvious that there will be some position of the drops, such as E, F, at which rays that have suffered *one* reflexion will reach the eye of the observer at O. Drops above these will throw the rays which they refract after one reflexion above O, and drops below these will throw the same rays below O. In like manner, there must be some position, as at H and G, at which other drops in which the light that has suffered two reflexions will fall upon the eye at O, the drops above these throwing the rays above, and the drops below them throwing the rays below O. Now, each drop forms by refraction a prismatic spectrum, or coloured and elongated image of the sun. The rays RE, RF, which reach the eye at O, must fall upon the lower drops E, F, on their upper side, as shewn in the figure, and consequently (as may be found by tracing the rays through the drops) the spectrum which they form will have the red rays uppermost, as at r, near F, and the *violet* rays downwards, as at v, near E; and as the same effect will be produced from all the other drops which reflect the sun's rays to the point O, there will appear to an eye at O, a coloured bow, such as we see it in the heavens, with all the colours of the spectrum, as if they had been formed from the sun's image, by a prism of water that produced the same degree of refraction. In like manner, the rays that enter the lower side of the drops will form an inverted spectrum, after *two* reflexions, in which the *red* rays are below, and the *violet* ones above, and as this spectrum is much fainter, it will give a second coloured bow, fainter than the first, and having its red side below, and its violet side above. The following are the dimensions of the two bows:—

Radius of the *red* edge of the *inner* bow....	42°	2′
——— *violet* edge..........................	40	17
Breadth of the inner bow......................	1	45
Radius of the *violet* edge of the *outer* bow	54	7
——— *red*..	50	57
Breadth of the outer bow............................	3	10
Distance between the bows..........................	8	55

Dr. Halley has shewn that the solar rays which suffer *three* reflexions, will form a bow round the sun at the distance of 40° 28′, and that those which suffer *four* reflexions will form a bow at the distance of 45° 33′ from the sun; but the light which reaches the eye after so many reflexions is too faint to be seen, and these bows have consequently never been discovered.

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Supernumerary *bows* of red and green light, to the number of *three*, have been seen in contact with the violet arch of the inner bow, and we have seen them also on the outside of the outer or secondary bow. The cause of these is not known, but a very ingenious explanation of them has been given in Chromatics, vol. xi. p. 634, sect. iii.

Sir David Brewster, upon examining the two rainbows with a rhomb of Iceland spar, found that they consisted wholly of *light polarised* in the plane of reflexion within the drop, or in planes coincident with the radii of the bow. The two bows present a case of *conical polarisation*, the part of the bow vanishing as the principal section of the rhomb becomes parallel to its radius. It is strange that the polarisation of the bow, and consequently of light, had not been discovered when it happened to be seen by reflexion on panes of glass, or other reflecting substances, lying with their planes of reflexion perpendicular to the planes of reflexion within the drop, and near the angle of maximum polarisation. See Meteorology, vol. xiv. p. 749.

Sect. II.—*On Halos and Parhelia.*

The name of *halos* and *parhelia* have been given to circles round the sun and moon, some of which are extremely complicated and beautiful. The general theory of this class of phenomena has been given by Dr. Young, in the article Chromatics, vol. vi. p. 634, sect. ii., and a description of the phenomena themselves, in the article Meteorology, vol. xiv. p. 749.

Artificial halos.

The production of halos, which have their origin in the refraction and reflexion of crystals of ice floating in the atmosphere, may be illustrated by the following method given by Sir David Brewster. A few drops of a saturated solution of alum spread over a plate of glass, so as to crystallise rapidly, will cover the glass with an imperfect crust, which is composed, when examined by the microscope, of flat octohedral crystals, scarcely visible to the eye. If the observer places his eye behind this plate, and close to its smooth side, he will see the sun or the candle encircled with three fine halos, placed at different distances. The interior one, which is the whitest, is formed by the refraction of the rays through two of the faces that have the least inclination to each other, and consequently give a spectrum in which the colours are not greatly dispersed; and as a similar pair of refracting planes lie in every direction, there will be a spectrum in every direction, and consequently a rainbow of a circular form. The second halo, which is *blue* without and *red* within, with all the intermediate prismatic colours more highly dispersed, is formed by a pair of faces more inclined. The third halo, which is larger and more brilliantly coloured, is produced by a third pair of refracting planes, having a greater refracting power, and consequently giving a higher dispersion. When the granular crystals have double refraction, and when they crystallise with their axes perpendicular to the plates, combinations of greater variety and beauty will be produced.

We have endeavoured, by looking through hoar frost upon glass, to produce halos actually resembling those seen in nature; but we have not succeeded, though we have no doubt that it may be effected by causing vapour deposited under a variety of circumstances, to be frozen in different ways.

Sect. III.—*On the Unusual Refraction of the Atmosphere.*

One of the most interesting applications of optical science

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is the explanation which it affords of the extraordinary phenomena which arise from difference of density in different parts of the atmosphere. As this subject has been treated very fully in our article METEOROLOGY, vol. xiv., and illustrated with some interesting figures, we shall confine ourselves at present to an account of the most extraordinary of all the phenomena of this kind which have been observed and correctly described. It was observed by Dr. Vince, on the 6th of August 1806, about seven o'clock in the evening. Between Ramsgate and Dover there is a hill, over which the tops of the four turrets of Dover castle are usually seen to a person at Ramsgate. At the time above mentioned, however, Dr. Vince, when at Ramsgate, not only saw the four turrets *v*, *x*, *w*, *y*, but the *whole of the castle*, *m*, *n*, *s*, *r*, appearing as if it were situated on the side of the hill next to Ramsgate, and rising as much above the hill AB as usual, *as if it had been brought over and placed on the Ramsgate side of the hill*, fig. 105. This appearance continued about twenty minutes. Between Ramsgate and the land from which the hill rises, there is about six miles of sea, and from thence to the top of the hill about the same distance, the height of the eye above the surface of the sea being about seventy feet. It is a very singular circumstance in this phenomenon, that the image of the castle was so very strong and well defined that the hill itself did not appear through the image.

Fig. 105.

In order to explain this phenomenon, Dr. Vince supposes AB, fig. 106, to represent the castle, FC the cliff of Ramsgate, BTD the hill, DC the sea, E the place of the spectator, T the top of the hill, A*yv*E a ray of light coming from the top of the castle to the observer, and B*xw*E another ray coming from the bottom of the castle, and T*xz*E a ray from the summit of the hill, reaching the eye at E, in a direction between those of the other two rays; then it is obvious that such a disposition of the rays will produce the observed appearance. In order to give such a refraction, the density of the air between *yv*E and *xw*E must have varied with great rapidity, so as to increase the curvature of the ray T*xz*E, after it cuts B*w*E in *x*, in order to make the ray T*xz*E fall between the other two rays. See *Edinburgh Transactions*, vol. vi. p. 245.

Fig. 106.

SECT. IV.—*On the Colours of the Atmosphere.*

Colours of the atmosphere.

As the earth's atmosphere acts upon light like all other transparent bodies, and is continually changing its chemical, mechanical, and hygrometrical condition, it acts upon light in very different ways, under different circumstances. As the colour of the sky is absolutely black on the tops of the highest mountains, its blue colour in the regions which we inhabit is owing to the action of the atmosphere.

That the *blue* light of the sky is light that has suffered reflexion from the particles of our atmosphere, is proved by the fact observed by Sir David Brewster, that this blue light is polarized in a plane passing through the observer's eye and the sun. This fact is well illustrated by the discovery which we owe to the same author, of *atmospheric lines* in the spectrum, formed by the blue sky. These lines are principally in the more refrangible spaces, as already described, and hence the prevailing light is blue.

The splendid colours which mark the rising and the setting of the sun, varying from the deepest *red* to *orange*, *yellow*, and even *green*, arise from the same cause; for when we analyse these various lights with the prism, we find that they are owing to definite parts of the spectrum having been absorbed by the atmosphere.

Blue shadows.

The phenomenon of blue shadows is finely seen when the sky is particularly blue. It arises solely from the shadows being illuminated by the blue sky, while the part round the shadow is illuminated by the sun, or by the light of a candle. If the light of the sun passes at the time through vapours so as to make it yellow or orange, the contrast of the shadow is still more striking and beautiful. The light of a candle which contains a great excess of red light, and which may be made to contain more by letting it burn with a long wick, exhibits along with the light of the sky the phenomenon of blue shadows in great perfection.

The subject of the blue colour of the sky has been treated at considerable length in our article on METEOROLOGY, vol. xiv. p. 760, and an instrument called a *Cyanometer*, for measuring its blue colour, has been well described, and an account of the experiments made with it fully detailed.

SECT. V.—*On the Colours of Natural Bodies.*

Colours of natural bodies.

The splendid colours which appear in the natural world have long attracted the attention of philosophers; but no person ever had the courage to give a philosophical theory of them but Sir Isaac Newton. When he had completed his analysis of the colours of thin plates, he conceived that they furnished the true cause of the colours of natural bodies. If we take a thin film of mica, a few millionths of an inch in thickness, it appears to the eye of a bright blue colour. Sir Isaac Newton maintained, that if this film could be cut into a great number of minute parts of the same thickness as itself, these particles would "keep their colour, and a heap of them constitute a mass or powder of the same colour which the plate exhibited before it was broken." A plate of mica of a different thickness, would be *green*, another *yellow*, and another *red*, and all these, if broken down into particles "of the same thickness with the plates," would of course, according to our author, give a *green*, a *yellow*, or a *red* mass.

We have already seen that different thickness of a transparent plate like mica, give various orders of colours; each different tint corresponding with a particular thickness. Considering then the particles of all bodies whatever as transparent, and as having different sizes, they will produce colours corresponding to these different sizes, and consequently we shall have as great a variety of tints in nature as there are varieties in the sizes of the particles of bodies. A difficulty, however, here presents itself. The colours arising from thin plates vary rapidly by inclining them to the incident light, whereas those of coloured media suffer no such change. Hence Sir Isaac Newton, was driven to the supposition that the particles of bodies have such an enormous refractive power, that the paths of the rays refracted by a parallel film will not differ much in length from, and consequently not be very oblique to, a perpendicular line. After explaining this theory, Sir Isaac ventures to affix to different natural colours the order to which they belong, the very tint of that order, and consequently the thickness of the particles which produce the colour. He says, for example, that the *green* colour of all vegetables, the most general tint in nature, is a GREEN of the *third* order, and that the *blue* colour of the sky is a *blue* of the *first* order. Now we know the composition of a *green* of the *third* order, and of a *blue* of the *first* order, as given by Sir Isaac Newton himself. The *green* of the *third* order "is principally constituted of *original green*, but not without a mixture of some *blue* and *yellow*;" that is, it consists of all the rays of the green space, with the least refrangible rays of the *blue* space, and the most refrangible rays of the *yellow* space, and it does not contain a single ray of *indigo*, *violet*, *orange*, or *red* light.

Such being the case, it occurred to Sir David Brewster that the green colour of plants could be accurately analysed by the prism, and having extracted by means of alcohol the green juice of a great variety of vegetable bodies, he analysed their colours by the prism. In all bodies he found the composition of this green colour to be identically the same; but it had no relation whatever to the *green* of the first order. It contained portions of all the colours of the

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spectrum; and the prismatic spectrum seen through these green juices was divided unequally into *six* luminous bands of various breadths, separated by dark intervals.[1] In the same manner he found that the *blue* colour of the sky was not a *blue* of the *first* order.

From a series of experiments in which the same author has been engaged, he has been led to the conclusion that absorption is the cause of this extensive class of colours; and that all the colours of natural bodies arise from the interference of light, by which certain rays are extinguished. When the interference takes place as in thin plates, between the light reflected from the two surfaces, and between the direct transmitted ray and other transmitted rays which suffer reflexion within the thin plates, we have two colours complementary to each other; but even in this case, when the number of films is great, as in decomposed glass, the transmitted colours lose all their resemblance to the colours of thin plates, while the reflected tints are exceedingly brilliant and metallic in their lustre.[2]

In coloured fluids and coloured glasses, and coloured gaseous media, the interference arises from rays that acquire different velocities in passing through the coloured medium, one part of the intromitted light passing through the particles, and the other through the intervening spaces. Hence there are no reflected tints in such coloured media.

Those who wish to study the Newtonian theory of the colours of natural bodies, are referred to Biot's *Traité de Physique*,[3] where it is illustrated and defended with all the sagacity and talent of that distinguished philosopher. See also an account of various ingenious experiments hostile to the theory, in a paper by Mr. Delaval in the *Manchester Memoirs*, vol. ii. p. 131.

SECT. V.—*On the Eye and on Vision.*

In our article on ANATOMY,[4] we have already given a full description of the organ of vision, and Plate XXXIII, fig. 3, exhibits a fine section of the eye after Soemmering. The following dimensions of the eye have been given by Dr. Thomas Young, the measures being taken with great care from his own eye:

	Hundredths of an inch.
Length of optical axis	91
Vertical chord of the cornea	45
Versed sine of ditto	11
Horizontal chord of the cornea	49
Aperture of the pupil seen through the cornea	27 to 13
Diminished in consequence of the magnifying power of the cornea	25 to 12
Radius of the anterior surface of the crystalline lens	30
Radius of the posterior surface	22
Distance of the optical centre from the anterior surface of the lens	10
Distance of the optical centre of the lens from the cornea	22
Focal length of the cornea for objects 10 inches distant	115
Joint focus of cornea and lens 91—22=	69
Principal focal distance of lens	173
Distance of the centre of the optic nerve from the point opposite the pupil	11
Range of the eye, or field of vision	110

The following measures of the crystalline lens and cornea were taken by Sir David Brewster and Dr. Gordon, from the eye of a female, above fifty years of age, a few hours after death.

Diameter of the crystalline	0·378
Diameter of the cornea	0·400
Thickness of the crystalline	0·172
Thickness of the cornea	0·042

The following measures of the refractive powers of the humours of the eye, were taken by the same authors from the same eye:

	Index of Refraction.
Refractive power of water	1·3358
Ditto of aqueous humour	1·3366
Ditto of vitreous humour	1·3394
Ditto of outer coat of crystalline	1·3767
Ditto of middle coat of ditto	1·3786
Ditto of central part of ditto	1·3990
Ditto of the whole crystalline	1·3839

The following measures may be occasionally useful:

	Index of Refraction.
From aqueous humour into the crystalline	1·0466
Do. do., taking the mean index of the crystalline,	1·0353
From the crystalline into the vitreous humour	0·930

Vision.

If we execute a large diagram of the eye, and by means of the above indices of refraction trace the progress of parallel rays from the cornea to the retina, we shall find that they converge to points in or near to that membrane. The increase of density in the crystalline lens towards its centre is calculated to correct the spherical aberration, by bringing the central rays to the same focus with the marginal rays; but there is no provision in the eye for correcting the aberration of colour, because the purposes of vision do not require it to be corrected. It may be readily proved by tracing the rays diverging from both extremities of any object to the retina, and it may be also shewn by direct experiment, that an inverted image of the object is formed upon that membrane. Now, it is a law of vision, that when a ray of light falls upon any point of the retina, the mind infers that the ray proceeded from a point in some line perpendicular to that point of the retina. Hence, as rays from the upper part of an object fall upon the lower part of the retina, and *vice versâ*, such rays will seem to proceed from the upper part of the object, and all points of an object will be seen in the direction of the rays which issue from them, and consequently the object itself *must* appear *erect*, though its image is inverted.

Cause of erect vision

Single vision with two eyes.

As it is a law of vision that an object seen with a single eye is seen in a fixed direction, arising from the form of the retina as a whole, or from the form of its individual parts, then if rays from the same object fall upon another eye, or upon a hundred other eyes which have the power of placing the retina of all the eyes, so as to see the same object in the same direction, then the object thus seen must appear single. The only difference will be, that the object will be seen twice as bright with two eyes, and a hundred times as bright with an hundred eyes. If we place a hundred shillings in the same straight line, an eye whose axis coincides with the axis of the cylinder which they compose, will only see one shilling, and the same effect would be produced if the shillings were transparent. If the hundred eyes were placed with their axes in a hundred different directions, an hundred objects will be seen. Small objects are seen double and even triple with one eye when the crystalline lens is not uniform in its refractive power.

Origin of squinting.

The defect of squinting may arise from several causes. It may be an original defect, in which the *axis of the eye*, or the line in which objects are seen most distinctly does not pass through the centre of the pupil. In this case it is incurable: but it is generally speaking a disease arising from an imperfection in one eye, from its having a different focal length from the other, from its giving a less distinct vision of objects, or from its muscles not being able to direct it as quickly as the other to visible objects. The consequence of this is, that as the observer can do without it, and uses only his best eye, the imperfect one does not follow the movements of the other, and therefore squints.

Indistinctness of oblique vision.

When we wish to see any object very distinctly, we invariably direct to it the axis of the eye, and it is a curious fact that there is no retina at the point where the axis meets the back of the eye, the *foramen centrale* corresponding to the

[1] See *Edinburgh Transactions*, vol. xii. [2] *Phil. Trans.* 1837, p. 245. [3] Tom. iv. p. 123. [4] Vol. ii. p. 798.

Explanation of natural phenomena.

extremity of the axis. When the eye thus sees an object with perfect distinctness, every other point of the same object is seen indistinctly, and there is no adjustment of the eye by which distinctness of vision can be obtained at any distance from the axis of the eye, the only way of seeing disinctly being to direct the axis to the point we wish to examine. The preceding fact leads to the opinion, that parts of an object seen in the retina cannot be seen distinctly, and yet if this were the case, we should be able to perceive upon an uniform ground the *foramen centrale.*

Indistinct vision at the base of the optic nerv

The opinion that the retina, though sensible to light, does not give perfectly distinct vision, is favoured by the fact, that when the image of any object falls upon the round base of the optic nerve, shewn in Plate XXXIII. fig. 3 of ANATOMY, the object is not distinctly visible. This may be easily proved by fixing on the wall of a room, at the height of the eye, three wafers each *two* feet distant. Stand in front of the middle wafer with one eye shut, and beginning near the wall, withdraw gradually from it, (continuing to view the *left* hand wafer if the *right* eye is open, and the *right* hand wafer if the *left* eye is open,) till the middle wafer vanishes. This will be found to take place at *five* times the distance from the wall at which the wafers are placed, that is, at the distance of *ten* feet in the present case. If we use three candles, the middle one will not vanish like the wafer, but will become a cloudy mass of light.

Occasional insensibility of the retina in oblique vision.

The occasional insensibility of the retina to objects seen obliquely, was discovered by Sir David Brewster, who has illustrated it in the following manner. If we fix one eye on a particular point, such as the head of a pin stuck into a green cloth, and lay down a quill or strip of paper upon the green cloth, some inches distant from the pin, and then keep looking steadily at the pin's head, part of the quill, or the whole of it, will occasionally disappear, as if it had been wholly removed from the cloth. In a short time it will reappear, and again vanish. The very same effect is produced, though less readily, when both eyes are used, and when a luminous body is used in place of the quill. In this case the luminous body does not disappear, but expands into a mass of nebulous light, which is of a *bluish white* colour, encircled with a bright ring of *yellow* light.

Superior brightness of objects seen obliquely.

But though we cannot see objects distinctly by oblique vision, yet they appear much brighter, and minute objects, especially luminous ones, are more easily seen by turning the axis of the eye away from them. Various astronomers have found that very faint stars, and the satellites of Saturn, which disappear when the eye is turned fully upon them, may be distinctly seen by directing the eye to another part of the field. This effect seems to arise from the expansion and enlargement of luminous points seen obliquely.[1]

On the seat of vision.

It has long been disputed, but the question has not been much agitated in modern times, whether the retina or the choroid coat behind it is the seat of vision. The insensibility of the base of the optic nerve, and the fact that vision is most distinct where there is no retina, are arguments in favour of the choroid coat being the seat of vision, as Mariotte believed. The transparency of the retina, and the opacity of the choroid coat were considered as additional arguments in favour of that opinion. Dr. Knox has shewn, that in the eye of the cuttle fish, there is a membranous opaque pigment in front of the retina, so that in this case the retina must receive the influence of light from the vibrations of this membrane just as it may receive them in other cases, from the same membrane placed behind it. M. Lehot, a living French author, has endeavoured to shew that the vitreous humour is the seat of vision; that we see the length, breadth, and thickness of every object as we do an image formed in smoke; and that the retina takes cognizance of this image in its three dimensions, by nervous filaments extending so far into the vitreous humour as to render any adjustment of the eye at different distances unnecessary.

Insensibility of the eye to faint light.

The insensibility of the retina to direct impressions of faint light, was discovered by Sir David Brewster,[2] who found, that when the eye directed its axis to objects faintly illuminated, it could not keep up a sustained vision of them. They disappeared and reappeared, and the eye was thrown into a state of painful agitation.

Duration of impressions on the retina.

When we shut the eye quickly after looking at an object, we see it for an instant (about the *seventh* part of a second) in its own colours; but this impression is instantly followed by an image of the object in its complementary colours. If we look at a window at the end of a long passage, we first see, after shutting our eyes, a picture of the window, with *black* bars and *white* panes; but after the *seventh* of a second the picture is one with *white* bars and *black* panes. When we whirl a burning stick, we see a complete circle of red light, although the burning end of the stick can only be in one part of the circle at the same instant. This affection of the retina is the principle of Dr. Paris's pretty toy, called the *Thaumatrope*, or *Wonder-turner*. A circular card with two strings is made to whirl rapidly round one of its diameters. If we draw a cage on one side of a card, and a bird on the other, and whirl the card round, we shall see the bird within the cage, the retina retaining the impression of both even when none of them are seen, which is the case when the edge of the card is directed to the eye.

Dr. Paris's thaumatrope.

Phenakistoscope or magic disc.

The same property of the retina to preserve impressions of light, is the principle on which that beautiful instrument, called the phenakistoscope, or magic disc, is founded. This instrument was, we believe, originally invented by Dr. Roget, and improved by M. Plateau, at Brussels, and Mr. Faraday. It consists of a circular disc from six to twelve inches in diameter, with rectilineal apertures on its margin in the direction of its radii. A series of figures, of a rider for example, leaping a fence, is drawn on the circumference of a circle, parallel to the rim of the disc. The *first* figure represents the rider and horse standing *before* the fence; and the *last* figure represents them standing *over* the fence when the leap is completed. Between these two figures there are several others, representing the rider and the horse in different parts of the leap. The observer then stands in front of a looking-glass, with the disc in his left hand, attached to a handle, and by a piece of simple mechanism he whirls it rapidly round, looking at its image on the glass through the notches in its margin. He is then surprised to see the horse and his rider actually leaping the fence, as if they were alive, and returning and leaping again as the disc revolves. If we look over the margin of the disc, at the reflected picture on the face of the disc, all the figures are effaced, and entirely invisible; but when we look through the notches, we only see the figure of the horse and rider at the instant the notch or aperture passes the eye, so that the picture instantaneously formed on the retina is not obliterated by preceding or subsequent impressions. Hence the eye receives in succession the pictures of the horse and rider in all the attitudes of the leap, which are blended, as it were, into one action. The apparent velocity with which the horse and rider advances (supposing the disc always to have the same velocity) depends on the proportion between the number of apertures in the margin of the disc, and the number of figures of the horse and rider.

If we use a disc with three concentric circles of apertures, each containing different numbers, 8, 10, and 12, for example, then considering that these apertures revolve in the opposite direction in the reflected image, it is obvious that when we look through the circle of 10, which moves from left to right at the image of 10, revolving in the mirror from right to left, these opposite motions will de-

[1] See *Lond. and Edin. Phil. Mag.* Sept. 1832, p. 169.

[2] *Edinburgh Journal of Science*, No. vi. p. 288.

stroy each other, and the circle of 10 apertures will appear to stand still in the picture. On the other hand, the circle of 12 apertures will always gain upon the one of 10, from which we look, and will appear to move from left to right, with the difference of the velocities of the two, while the one of 8 will move backwards with the same difference.

If we whirl a disc containing any word or figure upon it, without using a reflector, all is confused, and we cannot read the word or see the figure. Let it be whirled, however, in the dark, and let a spark of electricity, or the light of a little inflamed gun-powder, or of a percussion-cap, illuminate the disc, which it does only for an instant, and during that short instant, the word or figure will be seen to stop, and we shall read the one and see the other with great distinctness.

When objects are placed at different distances, the focus or point of distinct vision in the eye must vary. We feel that the eye has the power of adapting itself to these different distances, so as to make the picture on the retina always distinct. How this is done has been long a matter in dispute. There can be no doubt, however, that the first step in the process is the variation of the pupil, which seems by a mechanism at the base of the iris to increase the distance of the lens from the retina.

At the age of about forty, the eye loses this power of adaptation in consequence of the flattening of the crystalline lens, which renders it necessary to use a convex glass, which just compensates the flatness of the lens, and permits the eye to adjust itself as formerly. The opposite state of the eye, not produced by age, but rather diminished by it, is common even in young persons, arising either from a too great convexity or refractive power in the lens, or too great convexity in the cornea. In this state of the eye, the image is formed in front of the retina, and a concave lens is necessary to correct it. This is called *short-sightedness*, which almost always decreases by age in consequence of the crystalline lens becoming flatter.

When the eye looks steadily at a bright coloured *red* wafer, and then looks at the white paper on which the wafer lies, it will see for a while a *green* one, the green being the *accidental* colour, or the *complementary* one to the *red*. The *green* image is called an *ocular spectrum*, as it has no real existence. The *accidental colours* and the original colours are the same as those given in Newton's Table, p. 432, where the *reflected* tints correspond with the original or *red* colour of the wafer, and the *transmitted* ones to the accidental colour, or *vice versa*; so that we can determine from that table the accidental colours of any coloured object upon which the eye may look steadily.

When the eye looks at the sun, or a bright image of it, the ocular spectrum is not *black*, but of various colours in succession, each colour being surrounded with a rim of its accidental colour.

The following beautiful experiment, shewing the effect of light in diminishing the sensibility of the retina to particular colours, we owe to Mr. Smith, surgeon at Fochabers. Hold a slip of white paper vertically about a foot from the eye, and direct both eyes to an object beyond it, the slip will appear double, and the two images equally white. Let a candle be brought near the right eye, so as to act strongly upon it, without affecting the left, then the *left* image of the paper, or that seen by the right eye, will grow *green*, and the *right* hand image, or that seen by the *left* eye, will grow *red*, forming a beautiful contrast of colours. If the candle is brought round to the left eye, the images will first become of the same whitish colour, and then the *right* hand one will become *green*, and the left hand one *red*.[1]

The insensibility of the eye to particular colours is very uncommon. Professor Dugald Stewart, Dr. Dalton, and Mr. Troughton, were unable to distinguish the colours at the red end of the spectrum. All red objects appeared green, owing to the insensibility of their retinas to red colours. This subject has already been treated of in our article on Colours, vol. vii. p. 128.

Optical instruments.

PART IX. DESCRIPTION OF OPTICAL INSTRUMENTS.

Optical instruments.

The great number of optical instruments which have been described in different parts of this work, renders it scarcely necessary to treat this subject in the general article. Under the articles Burning Instruments, Camera Lucida, Kaleidoscope, Micrometer, Microscope, Photometers, and Telescope, the reader will find the information, some of which he might have expected here. There are instruments, however, so intimately connected with Optics, and not previously described, which we must shortly notice, namely, the *Cylindrical Mirror*, the *Camera Obscura*, the *Magic Lantern*, and the *Phantasmagoric Machine*.

1. *Cylindrical Mirror.*

Cylindrical mirrors. Fig. 107.

We have already (see p. 382) described the principle of cylindrical mirrors. If we suppose one of these mirrors, AB, fig. 107, to be placed on a table, with the portrait of any person laid before it on the table, the reflected picture of the portrait in the cylindrical mirror will be distorted. If we take an accurate drawing of this distorted picture and lay it before a cylindrical mirror, as shown at MN, where the human form can scarcely be recognised, we shall see in the cylindrical mirror its image reduced to symmetry.

2. *On the Camera Obscura.*

Camera obscura.

We have already explained the principle of the camera obscura in treating of the images formed by convex lenses. The instrument is indeed nothing more than a convex lens placed in a suitable box, on the side or bottom of which an image of external objects is formed by the lens.

Fig. 108.

A convenient portable camera obscura for drawing objects is shown in fig. 108. The external object or landscape is reflected down into the lens AB by an inclined mirror CD. The rays thus falling vertically upon the lens, are refracted to their foci, and form a distinct image of the landscape on the paper placed at EF. On one side of the box there is an opening through which the observer introduces his head and hand, care being taken, by a curtain of black cloth behind him, to exclude all extraneous light. M. Cauchoix of Paris has found that the best form of the lens for a camera is a meniscus, having its convex surface towards the image, and its concave surface towards the object, and their radii of curvature as 5 to 8.

3. *On the Magic Lantern.*

Magic lantern. Fig. 109.

The magic lantern, an invention of the celebrated Athanasius Kircher, is shewn in fig. 109. It consists merely of a lens AB, which forms on the wall of a dark room a picture of any object placed before it, and at a greater distance than its anterior principal focus. The light of an argand lamp is thrown in a condensed state by the illuminating lens D, upon transparent varnished pictures painted on long sliders. The lens AB forms a large circle of light upon the wall, which, if it is not smooth and white, should be covered with a white smooth cloth, and the images of the coloured figure appear within this circle.

A magic lantern is the same as a solar microscope, the

[1] An analysis of this and similar experiments will be found in the *Lond.* and *Edin. Phil. Mag.* Ed. 1832, p. 249.

Optical instruments || Optimates.

sun being used for the source of light in the latter case, and natural objects in place of pictures. The *solar camera microscope* invented by Dr. Goring, and fully described in our article MICROSCOPE, vol. xv. p. 46, and the *oxyhydrogen microscope*, described in the same article, may be considered as the most perfect magic lanterns that have been constructed, there being no difficulty in adapting them to give magnified representations of minute transparent paintings.

4. *On the Phantasmagoric Apparatus.*

Phantasmagoric apparatus.

The apparatus for the *phantasmagoria*, or the raising of spectres, is nothing more than a magic lantern mounted upon wheels, which, in place of throwing its pictures upon an opaque white ground, upon which the spectator looks, throws them upon one side of an imperfectly transparent screen, the spectator viewing them on the other side of the screen. The direct light of a lamp A, fig. 110, and the light reflected from the concave mirror B, is thrown upon the two illuminating lenses C, D, which condense it, and thus strongly illuminate the spectres and figures painted upon sliders at E. These sliders are placed a little before the anterior focus of the magnifying lens F, which forms a highly magnified picture of the figures on the transparent screen at G. When this apparatus is mounted upon a carriage with wheels, as at H, it may be made to approach to, or recede from, the screen G, in consequence of which the figures may be made to contract into dwarfs, disappearing in a point of light, or swell out into giants of enormous magnitude. In order, however, to have the pictures distinct at different distances of the apparatus from the screen, an adjustment is necessary, to make the distance EF increase as the apparatus approaches to G, and diminish as it recedes from it. With this view, the lens F is fixed to a slider, which may be drawn out by the general frame H. When this frame H is drawn away from the screen, the point K is brought lower by means of the rod IK, connected with another rod KN fixed to the frame of the screen at N, where there is a joint or centre of motion. The descent of the point K causes another lever KL to move the horizontal slider (which carries the lens F) in such a manner as to keep the screen always in the focus of F, and consequently the picture upon it always distinct. When the frame H, on the other hand, advances to the screen, the point K rises, and the lens F is again adjusted by the motion of the slider. When the images diminish and appear to vanish, the support of the lens F permits the screen M to fall and intercept part of the light. The screen M may have a triangular opening, so as to uncover the middle only of the lens F. In this adjusting apparatus the rods KN and KL must be equal, and the point I must be twice the focal length of the lens F before the object, L being immediately under the focus of the lens. The object of the screen M is to diminish the illumination of the objects as they get smaller and appear to retire from the spectator, because in the instrument they actually become brighter.

Fig. 110.

When M. Robertson exhibited this remarkable instrument, living persons were often strongly illuminated and introduced into the picture. The effect of life, however, was better given when the shadows of living objects only were introduced.

For farther information on the subject of this article, see ASTRONOMY, vol. iv. p. 101, chap. iv. ACHROMATIC TELESCOPES, BURNING INSTRUMENTS, CAMERA LUCIDA, CHROMATICS, COLOURS, KALEIDOSCOPE, METEOROLOGY, MICROMETER, MICROSCOPE, PHOTOMETER, and TELESCOPE.

OPTIMATES, one of the divisions of the Roman people, and opposed to *populares*. It is not easy to ascertain the characteristic differences of these two parties. Some say the *optimates* were warm supporters of the dignity of the chief magistrate, and promoters of the grandeur of the state, caring not if the inferior members suffered, provided the superior powers were advanced; whereas the *populares* boldly contended for the rights of the people, claimed larger privileges, and laboured to bring matters nearer to an equality. In short, according to this account, they resembled the court and country parties amongst the people of this island. Cicero says that the *optimates* were the best citizens, who wished to deserve the approbation of the better sort; and that the *populares* courted the favour of the populace, not so much considering what was right, as what would please the people and gratify their own thirst of vain-glory and applause.

OPTIO, an officer in the Roman army, who was an assistant or lieutenant to the centurion. The *optio* was so called because in later times he was the choice or option of the centurion; at first, however, he derived his appointment from the tribune or commander of the legion. Sometimes the *optiones* were also called *succenturiones* and *tergiductores;* the latter name having been given them because their post was in the rear of the company. Several authors mention *sub-optiones* or sub-lieutenants. It is proper, however, to add, that *optiones* were not peculiar to the camp, but were also employed in a variety of other offices.

OR, the French word for gold, by which this metal is expressed in heraldry. In engraving it is denoted by small points all over the field or bearing.

ORA, in *Antiquity*, was a term equivalent to ounce; but it has been much debated amongst our antiquaries, whether the ora, the mention of which so often occurs, was a coin, or only money of account. Dr Hickes observes, that the mode of reckoning money by marcs and oras was never known in England until after the settlement of the Danes; and by examining the old nummulary estimates amongst the principal Gothic states upon the Baltic, it appears that the ora and *solidus* were synonymous terms, and that the ora was the eighth part of the marc. From several of the Danish laws, it likewise appears that the Danish ora, derived by corruption from *aurea*, was the same as the Frank *solidus* of twelve pence. As a weight, the ora was regarded as the *uncia* or unit, by which the Danish marc was divided; and in Doomsday-book the ora is used for the ounce, or the twelfth part of the nummulary Saxon pound, and the fifteenth of the commercial. As a coin it was an *aureus*, or the Frank *solidus* of twelve pence; and from the accidental coincidence of the Frank *aureus* with the eighth part of the marc, the Danes probably took occasion to give it the new name of ora. Another ora is mentioned in the rolls of the 27th of Henry III. the value of which was sixteen pence; and this was probably derived from the half mancus of the Saxons, as there were no *aurei* of that period to which these two denominations of money of sixteen and twelve pence could possibly be ascribed. It may be further observed, that the name ora distinguishes the gold coins in several parts of Europe to this day. The Portuguese moidore is nothing else but *moeda d'oro*, from the Latin *moneta de auro;* the French *louis d'or* comes from the same use of the word, and owes its appellation to the ora.

ORACLE, amongst the heathens, was the answer which the gods were supposed to give to those who consulted them upon any affair of importance. It is also used for the god who was thought to give the answer, and for the place where the response was given.

The credit of oracles was so great that in all doubts and disputes their determinations were held as sacred and inviolable. Hence vast numbers flocked to them for advice about the management of their affairs; and no business of any consequence was undertaken, scarcely any peace concluded, any war waged, or any new form of government instituted, without the advice and approbation of some oracle. The answers were usually given by the intervention of the priest or priestess of the god who was consulted; and were generally expressed in such dark and unintelligible phrases, as might easily be wrested to prove the truth of the oracle, whatever the event should happen to be. It is not, therefore, to be wondered at, that the priests who delivered them were in the highest credit and esteem; and that they managed this reputation so as greatly to promote their own particular advantage. They accordingly allowed no man to consult the gods before he had offered costly sacrifices and made rich presents to them. Nor was this all. To keep up the veneration for their oracles, and to prevent their being taken unprepared, they admitted persons to consult the gods only at certain stated times; and sometimes they were so cautious, that the greatest personages could obtain no answer at all. Thus Alexander himself was peremptorily denied by the Pythia or priestess of Apollo, till she was by downright force obliged to ascend the tripos, when, being unable to resist any longer, she cried out, "Thou art invincible;" and these words were accepted instead of any further oracle.

When men began to be better instructed by the lights which philosophy had introduced into the world, the false oracles insensibly lost their credit. Chrysippus filled an entire volume with false or doubtful responses. Œnomaus, to be revenged of some oracle which had deceived him, made also a compilation of responses, to show their ridiculous vanity. Eusebius has preserved some fragments of this criticism on oracles by Œnomaus. "I might," says Origen, "have recourse to the authority of Aristotle and the Peripatetics, to make the Pythoness much suspected; I might extract from the writings of Epicurus and his followers an abundance of things to discredit oracles; and I might show that the Greeks themselves made no great account of them."

The reputation of oracles was greatly lessened when they became an artifice of politics. Themistocles, having the design of engaging the Athenians to abandon Athens, and to embark on board of their ships, in order to be in a better condition to resist Xerxes, made the Pythoness deliver an oracle, commanding them to take refuge in wooden walls. Demosthenes said, that the Pythoness "philippized," to signify that she was gained over by Philip's presents.

The cessation of oracles is attested by several profane authors, as Strabo, Juvenal, Lucian, and others. Plutarch accounts for it, by saying that the benefits of the gods are not eternal as themselves are; that the genii who presided over oracles are subject to death; and that the exhalations of the earth had been exhausted. It appears that the last reason had been alleged in the time of Cicero, who ridicules it in his second book on Divination; as if the spirit of prophecy, supposed to be excited by subterraneous effluvia, had evaporated by length of time, as wine or other liquors by being long kept.

Suidas, Nicephorus, and Cedrenus, relate that Augustus, having consulted the oracle of Delphos, could obtain no other answer but this: "The Hebrew child, whom all the gods obey, drives me hence, and sends me back to hell; get out of this temple without speaking one word." Suidas adds, that Augustus dedicated an altar in the capitol, with this inscription, "To the eldest Son of God." But notwithstanding these testimonies, the answer of the oracle of Delphos to Augustus seems very suspicious. Cedrenus cites Eusebius for this oracle, which is not now found in his works; and the peregrination of Augustus into Greece took place eighteen years before the birth of Christ.

Suidas and Cedrenus also give an account of an ancient oracle delivered to Thulis, a king of Egypt, which they assure us is well authenticated. The king having consulted the oracle of Serapis, to know if there ever was, or would be, one so great as himself, received this answer: "First God, next the Word, and then the Spirit with them; they are equally eternal, and make but one whose power will never end; but do thou, mortal, get thee hence, and think that the end of the life of man is uncertain."

Van Dale, in his treatise of oracles, does not believe that they ceased at the coming of Christ. He relates several examples of oracles which were consulted until the death of Theodosius the Great; and he quotes the laws of the Emperors Theodosius, Gratian, and Valentinian, against those who consulted oracles, as affording certain proof that the superstition of oracles still subsisted in the time of those emperors. But others conceive that the opinion of those who believe that demons had no share in the oracles, and that the coming of the Messiah made no change in them, as well as the contrary opinion of those who pretend that the incarnation of the Word imposed a general silence on all oracles, should all be equally rejected. They allege that two sorts of oracles ought to be distinguished; the one dictated by the spirits of darkness, who deceived men by their obscure and doubtful answers; the other, the pure artifice and deception of the priests of false divinities. As to the oracles given out by demons, the reign of Satan was destroyed by the coming of the Saviour; truth shut the mouth of lies; but Satan still continued his old craft amongst idolaters. All the devils were not reduced to silence at the same time by the coming of the Messiah; it was only on particular occasions that the truth of Christianity and the virtue of Christians imposed silence on the devils. St Athanasius tells the Pagans that they had themselves been witnesses of the sign of the cross having put the devils to flight, silenced oracles, and dissipated enchantments. This power of silencing oracles, and putting the devils to flight, is also attested by Arnobius, Lactantius, Prudentius, Minutius Felix, and several others, whose testimony affords certain proof that the coming of the Messiah had not imposed a general silence on oracles.

Plutarch relates, that the pilot Thamus heard a voice in the air, crying out, "The great Pan is dead;" upon which Eusebius observes, that the accounts of the death of the demons were very frequent in the reign of Tiberius, when Christ drove out the wicked spirits. Indeed the same judgment may be passed on oracles as on *possessions*. It was on particular occasions, by the divine permission, that the Christians cast out devils, or silenced oracles, in the presence, and even by the confession, of the Pagans themselves; and thus it is that we should understand the passages of St Jerome, Eusebius, Cyril, Theodoret, Prudentius, and other authors, who have said that the coming of Christ imposed silence on the oracles.

As to the second sort of oracles, which were pure artifices and deceptions of the priests of false divinities, and which probably exceeded the number of those which immediately proceeded from demons; they did not cease till idolatry was abolished, though they had lost their credit for a considerable time before the coming of Christ. It was concerning this more common and general sort of oracles, Minutius Felix observed, that they began to discontinue their responses, according as men began to be more enlightened. But, however oracles were decried, impostors always found dupes, and the grossest cheats almost never failed to deceive.

Daniel discovered the imposture of the priests of Bel, who had a private way of getting into the temple to take away the offered meats, and who made the king believe that the idol had consumed them. Mundus, being in love with Paulina, the eldest of the priestesses of Isis, went and told her, that the god Anubis, being passionately fond of her, commanded her to give him a meeting. She was afterwards shut up in a dark room, where her lover Mundus, whom she believed to be the god Anubis, was concealed. This imposture having been discovered, Tiberius ordered those detestable priests and priestesses to be crucified, and with them Idæa, the freed-woman of Mundus, who had conducted the whole intrigue. He also commanded the temple of Isis to be levelled with the ground, and her statue to be thrown into the Tiber; but as to Mundus, he contented himself with sending that person into banishment.

Theophilus, bishop of Alexandria, not only destroyed the temples of the false gods, but discovered the cheats of the priests, by showing that the statues, some of which were of brass, and others of wood, were hollow within, and led into dark passages made in the wall.

Lucian, in discovering the impostures of the false prophet Alexander, says that the oracles were chiefly afraid of the subtilties of the Epicureans and the Christians. The false prophet Alexander sometimes feigned himself seized with a divine fury, and by means of the herb sopewort, which he chewed, frothed at the mouth in so extraordinary a manner that the ignorant people attributed it to the power of the god by whom he was possessed. He had long before prepared a head of a dragon made of linen, which opened and shut its mouth by means of a horse-hair. He went by night to a place where the foundations of a temple were digging; and having found water, either of a spring, or of rain which had settled there, he hid in it a goose egg, in which he had enclosed a little serpent that had just been hatched. The next day, very early in the morning, he came quite naked into the street, having only a scarf about his middle, holding in his hand a scythe, and tossing about his hair like the priests of Cybele; then getting on the top of a high altar, he said that the place was happy to be honoured by the birth of a god. Afterwards, running down to the place where he had hidden the goose egg, and going into the water, he began to sing the praises of Apollo and Æsculapius, and to invite the latter to come and show himself to men. At these words, he dipped a bowl into the water, and took out the mysterious egg, which had a god enclosed in it; and when he had it in his hand, he began to say that he held Æsculapius. Whilst all were eager to have a sight of this fine mystery, he broke the egg, and the little serpent starting out, twisted itself about his fingers.

These examples show clearly that both Christians and Pagans were so far agreed as to treat the greater number of oracles as purely human impostures. That in fact *all* of them were so, will perhaps be concluded by those who give equal credit to demoniacal inspiration and demoniacal possession. The most ancient oracle was that of Dodona; but the most famous was that of Delphi, which performs such a prominent part in Pagan antiquity. Another celebrated one was the oracle of Trophonius, in the neighbourhood of Lebadia, a city of Bœotia. It was held in high estimation, and received its name from Trophonius, brother of Agamedes, who lived in a subterranean dwelling near Lebadia, and pretended to possess the faculty of foretelling future events. He died in his cave, and was deified as an oracular divinity. This oracle owed its reputation to one Saon. Those who repaired to this cave for information were required to offer certain sacrifices, to anoint themselves with oil, and to bathe in a certain river. They were then clothed with a linen robe, took a honeyed cake in their hands, and descended into the subterranean chamber by a narrow passage; and here it was that futurity was unfolded to them, either by visions or by extraordinary sounds. The return from the cave was by the same passage; but the persons consulting the oracle were obliged to walk backwards. They generally came out astonished, melancholy, dejected; and hence the proverb *ἐις Τροφωνιου μεμαντευται*. The priests, on their return, placed them upon an elevated seat, called the seat of Mnemosyne, where an account was taken of what they had seen and heard. They were then conducted by their companions to the chapel of good Genius, where, by degrees, they recovered their usual composure and cheerfulness.

Besides these three principal oracles of Greece, it is proper to take notice of that of Amphiaraus at Oropius, in Attica. It was so called from Amphiaraus, the son of Oicleus, a man deeply skilled in magic, the interpretation of dreams, and the like, who, after his death, was deified, and delivered oracles in a temple erected to his divinity. Those who applied for information were required to purify themselves, offer sacrifice, fast twenty-four hours, abstain from wine two days, and make an offering of a ram to Amphiaraus; they were then to sleep on the skin of the animal, and to see their destiny in a dream. Near the temple was the fountain of Amphiaraus, which was deemed sacred, the waters of it being forbidden to be used for ordinary purposes.

At Delos there was also an oracle of the Delian Apollo; in Milesia there was that of the Branchidæ; and there were others of less note, which do not require particular description, such as that of the camps at Lacedæmon, that of Nabarcha, that of Chrysopolis, that of Claros in Ionia, that of Mallos, that of Patarea, that of Pella, that of Phasellides, that of Sinope, that of Orpheus' head, and a few more, which it is unnecessary to mention.

Although the Romans upon many occasions consulted the Grecian oracles, and had but few in their own country, yet we must not omit mentioning the oracles which were delivered by the Sibyl of Cumæ, and enjoyed great celebrity. They have been frequently alluded to by Virgil.

We have hitherto only considered the oracles of false gods, of which there was a far greater number than our limits permit us to enumerate, and before either Greeks or Romans had risen to any distinction. Oracle is in sacred history sometimes used for the mercy-seat, or the cover of the ark of the covenant; and by others it is taken for the sanctuary, or the most holy place, in which the ark was deposited.

Amongst the Jews may be distinguished several kinds of real oracles. They had first oracles which were delivered *viva voce*, as when God spake to Moses face to face, as one friend speaks to another;[1] secondly, prophetical dreams sent by God, as the dreams which God sent to Joseph, and which foretold his future greatness;[2] thirdly, visions, as when a prophet in an ecstasy, being neither properly asleep nor awake, had supernatural revelations;[3] fourthly, the oracle of Urim and Thummim, which was accompanied with the ephod or the pectoral worn by the high priest, and which God had endued with the gift of foretelling things to come.[4] This manner of inquiring of the Lord was often made use of, from Joshua's time till the erection of the temple at Jerusalem. Fifthly, after the building of the temple, they generally consulted the prophets, who were numerous in the kingdom of Judah and Israel. From Haggai, Zechariah, and Malachi, who are the last of the prophets any of whose writings remain, the Jews pretend that God gave them what they call *Bathcol*, or the daughter of the voice, which was a supernatural

[1] Numb. xii. 8.
[2] Gen. xxxvii. 5, 6.
[3] Gen. xv. 1; xlvi. 2.
[4] Numb. xii. 6; Joel, ii. 28.

manifestation of his will, and was performed either by a strong inspiration or internal voice, or else by a sensible and external voice, which was heard by a number of persons sufficient to bear testimony to the fact. For example, such was the voice that was heard at the baptism of Jesus Christ, saying, " This is my beloved Son, in whom I am well pleased; hear ye him."[1]

The Scripture likewise affords us examples of profane oracles. Balaam, at the instigation of his own avarice, and fearing to lose the recompense which had been promised him by Balak, king of the Moabites, suggested to this prince the diabolical expedient of making the Israelites fall into idolatry and fornication;[2] by which he assured him of a certain victory, or at least of considerable advantage against the people of God.

Micaiah the son of Imlah,[3] a prophet of the Lord, says that he saw the Almighty sitting upon his throne, and all the host of heaven round about him; and the Lord said, who shall tempt Ahab king of Israel, that he may go to war with Ramoth-gilead, and fall in the battle? One answered after one manner, and another after another. At the same time an evil spirit presented himself before the Lord, and said, I will seduce him. And the Lord asked him, how? To this Satan answered, I will go and be a lying spirit in the mouth of his prophets. And the Lord said, Go, and thou shalt prevail. This dialogue clearly proves these two things: first, that the devil could do nothing by his own power; and, secondly, that, with the permission of God, he could inspire the false prophets, sorcerers, and magicians, and thus make them deliver false oracles.

Respecting the cessation of profane oracles, there have been a variety of opinions, some of which we have already noticed. It has been generally held, indeed, that oracles ceased at the birth of Jesus Christ. Yet some have endeavoured to maintain the contrary, by showing that they were in existence in the days of Julian, commonly called the Apostate, and that this emperor himself consulted them; that history makes mention of several laws published by the Christian emperors Theodosius, Gratian, and Valentinian, to punish persons who interrogated them, even in their days; and that the Epicureans were the first who made a jest of this superstition, and exposed to the people the roguery of the priests. As we suspect most of the facts here asserted should be understood in a qualified sense, we shall endeavour to discuss this point of controversy in as few words as possible, although it is undoubtedly a matter of some consequence.

1st, The question, properly stated, is not, whether oracles became extinct immediately upon the birth of Christ, or from the very moment when he was born; but, whether they fell gradually into disesteem and ceased, as Christ and his gospel became known to mankind. And that they did so, is most certain from the concurrent testimonies of the fathers, which none can attempt to invalidate, without being prepared to give up the most respectable traditions and relations of every kind.

2dly, But did not Julian the Apostate actually consult these oracles? We answer in the negative. He had indeed recourse to magical operations, but it was because oracles had already ceased; for he bewailed the loss of them, and assigned for their cessation pitiful reasons, which St Cyril has vigorously refuted, adding, that Julian " never could have offered such, but from an unwillingness to acknowledge that, when the world had received the light of Christ, the dominion of the devil was at an end."

3dly, The Christian emperors do indeed condemn the superstition and idolatry of those who were still disposed to consult oracles; but the edicts of these princes do not prove that oracles actually existed in their times, any more than that they had ceased in consequence of their laws. It is certain that they were for the most part extinct before the conversion of Constantine.

4thly, Some Epicureans might make a jest of this superstition; but the Epicurean philosopher Celsus, in the second century, was disposed to cry up the excellency of several oracles, as appears at large from Origen's seventh book against him.

ORÆA, certain solemn sacrifices of fruits, which were offered in the four seasons of the year, in order to obtain mild and temperate weather. They were offered to the goddesses who presided over the seasons, attended upon the sun, and received divine worship at Athens.

ORAL, something delivered by word of mouth, without being committed to writing. In this sense we say oral law, oral tradition, oral communication, and the like.

ORAN, WARRAN, AURAN, or GUHARAN, a famous maritime city of Algiers, and the most westerly in the regency. It is built on the declivity and along the foot of a high mountain, which overlooks it from the north and northwest; and on this ridge are planted two castles, commanding the city on the one side and the port on the other. To the south and south-east there are two other castles, erected upon the same level with the lower part of the city, but separated from it by a deep winding valley, which serves as a natural trench on the south side. A rivulet flows through it, and passing afterwards under the walls of the city, affords a copious supply of water. At every opening of this valley a pleasing and varied prospect presents itself, of rocky precipices, orange plantations, and rills of water winding down the heights. Near the head of the rivulet just mentioned there is a fifth castle, which not only guards the *mattamores* dug under its walls, but serves as an important defence to the city. Yet strongly fortified as Oran is, both by nature and art, it has been repeatedly taken by the Spaniards, between whom and the Moors it was for centuries a subject of contention. It was taken by the former in the year 1509, but was recovered by the Moors in 1708. In the year 1732 the Spaniards retook it by surprise; the Bey, otherwise a valiant soldier, having been panic-struck on the first landing of the enemy, and, without shutting the gates, abandoned the city to their mercy. Oran was afterwards restored, and, along with other parts of Algiers, has recently fallen under the dominion of France. During the time that the Spaniards retained possession of Oran, they erected several beautiful churches, and other edifices, in the style of the Roman architecture, though of less strength and solidity. They have further imitated the Romans in carving upon the friezes and other parts several inscriptions in large characters, and in their own language. Shaw describes Oran as a fortified city, about a mile in circumference. The port called Mer-el-Quiver, corrupted from Mers-el-Kibeer, and answering to the ancient Portus Magnus, is formed by a neck of land, which runs out almost a furlong into the bay, and thereby secures it against the north and northwest winds. It is defended by a castle more remarkable for spaciousness and extent than for strength or beauty, though a part of it has been skilfully hewn out of the native rock. Oran has much declined of late years, as the occupation of the place by the French has induced the Arab population to leave it, although the former repaired some of the edifices, and converted an old mosque into an hospital. The inhabitants are estimated at about 4000. In the year 1790 this city was destroyed by an earthquake, and six thousand of its inhabitants were buried under the

[1] Matth. iii. 17.

[2] Numbers, xxiv. 14; xxxi. 16.

[3] 1 Kings, xxii. 19, &c.

ruins. Oran is situated in 35. 50. north, and longitude 0. 18. west.

ORANGE, an arrondissement of the department of the Vaucluse, in France, extending over 406 square miles. It comprehends seven cantons, divided into fifty communes, and contains 69,443 inhabitants. The capital, a city of the same name, is the seat of a bishop, and of some courts of law. It stands on a fruitful plain, watered by the river Meyne. It has large lofty houses, with narrow and crooked streets, a cathedral, a Protestant church, two hospitals, 1540 houses, and 8874 inhabitants, who make cotton, woollen, and silk goods, besides oil, wine, brandy, madder, and paper. It is in latitude 49. 4. N., and longitude 8. 8. east. It is remarkable as the district whence the house of Nassau derived its title as prince, which it has retained without the territory. The vicinity of the city exhibits many curious remains of Roman antiquity, especially a triumphal gate of three arches, half a mile from it, on a theatre, the walls of which are 108 feet in height. A part of this building has of late years been converted into a prison.

ORANGE River, a large river of Southern Africa, which derives its origin from the waters of the Snowy Mountains, in the district of Graaf-Reynet, nearly at the north-eastern extremity of the colony of the Cape of Good Hope. It is formed chiefly by two rivers, the Ky Gariep or Yellow River, and the Nu Gariep or Black River, which unite their waters in latitude 29. 4., upwards of five hundred miles due east from their mouth. The latter branch, flowing from the south-east, is called, higher up, the Cradock River, and receives the Sea-Cow River and some other streams from the Sneuwbergen. The Muddy or Alexander River, flowing also from the south-east, falls into the Yellow River above its confluence with the Nu Gariep. The former river, the Ky Gariep, comes from the north-east, and is formed by the union of the Vaal River with the Hart stream or Malalareen. After the junction of these two streams, the Orange River flows at first in a north-westerly course, but afterwards bends to almost due west, which bearing it maintains until it falls into the Atlantic in latitude 28. 30. north. In the eastern part of its course it forms the limit between the territory of the Hottentots and that of the Boshuanas; the country on the south presenting an entirely different character of animal and vegetable life from that on the north. In its westerly course this river winds its way through a desert of a clayey or swampy character; the sandstone rocks rising in perpendicular walls, which are often prolonged to a vast extent. The country retains the same aspect for a considerable space on both sides of the river; and the heat is here very great and oppressive. The course of the Orange River, including its windings, must considerably exceed one thousand miles.

Orange, Sea, in *Natural History*, a name given by Count Marsigli to a very remarkable species of marine substance, which he denominates a plant. It is tough and firm in its structure, and in many things resembles the common fucus; but instead of growing in the branched form which the generality of these substances assume, it is round and hollow, and in every respect resembles the shape of an orange. It has, by way of root, some exceedingly fine filaments, which fasten themselves to the rocks, or to shells, stones, or any thing else that comes in the way. From these there grows no pedicle; but the body of the orange, as it is called, is fastened by them to the rock, or other solid substance. The orange itself is usually about three or four inches in diameter; and whilst in the sea it is full of water, which it retains even when taken up. In this state it frequently weighs a pound and a half; but when the water is let out, and it is dried, it becomes a mere membrane, weighing scarcely any thing. It is best preserved by stuffing it with cotton as soon as the water is let out of it, and then hanging it up to dry. Its surface is irregular and rough, and its colour is a dusky green on the outside, and a clearer but somewhat bluish green within; and its thickness is about an eighth part of an inch. When viewed by the microscope, it is observed to be all over covered with small glandules, or rather composed of them; for they stand so thick one by another, as to leave no space between, and seem to constitute the whole substance; so that it appears very like the rough shagreen skin used to cover toys. These are indeed so many hollow ducts, through which the sea-water finds a passage into the globe formed by this skin, and by this means it is kept always full and distended. On cutting it with a pair of scissors, the water immediately runs out, and the skins collapse; but there is something extremely remarkable in this, for the whole substance, near the wounded place, is in motion, and seems as if alive, and sensible of the wound. The glandules are found full of water, resembling small transparent bottles; and what goes to the structure of the plant besides these, is an assemblage of a vast number of filaments, all of which are likewise hollow, being filled with a clear and transparent fluid.

ORATION, in *Rhetoric*, a speech or harangue, composed according to the rules of oratory, but spoken in public.

ORATOR, amongst the Romans, differed from a *patronus*. The latter was allowed only to plead causes on behalf of his clients; whereas the former might quit the forum, and ascend the rostra or tribunal, to harangue the senate or the people. The orators had rarely a profound knowledge of the law; but they were eloquent, and their style was generally correct and concise. They were employed in causes of importance, instead of the common patrons. Orators, in the violence of elocution, used the utmost animation of gesture, and even walked backwards and forwards with great heat and emotion. This it was which gave occasion to a witticism of Flavius Virginius, who asked one of these walking orators, *Quot millia passuum declamâsset?* "How many *miles* he had declaimed?" Similar to the Roman orators were the Grecian *rhetores*.

ORATORIO, in *Music*, a kind of sacred drama, in which the poetry is derived from some scriptural subject, and is set to music in recitatives, airs, duetts, trios, quartetts, &c. and choruses, accompanied by an orchestra, sometimes an organ, and introduced by an instrumental overture. The origin of the oratorio is not clearly established. Amongst the most remarkable oratorios of modern times is Haydn's "Creation."

ORATORY, the art of speaking well upon any subject, so as to persuade or convince. See Rhetoric.

Oratory, amongst the Roman Catholics, means a closet or small apartment near a bed-chamber, furnished with an altar and crucifix, for private devotions.

ORBE, a small city of Switzerland, in the canton of Vaud, on the river of the same name, across which there is a stone bridge. It contains 280 houses, with 1400 inhabitants. Anciently it was one of the largest of the cities in the country, and in the time of the Romans was, under the name of Urbigenum, the capital of Helvetia. In the middle ages the kings of the Franconian race had their palace here, and gave their splendid festivals; but in the Burgundian wars it suffered greatly, and declined so much as to become subject to the cantons of Berne and Friburg. It now contains some large houses. The inhabitants chiefly depend on agriculture, but have some trade with Geneva and Yverdun.

ORCHARD, a department in gardening, allotted entirely to the growth of standard fruit-trees, for furnishing a large supply of the most useful kinds of fruit. See Horticulture.

ORCHESTRA, in *Music*. See the article Music.

Ordeal.

ORCHESTRA, in the Grecian theatres, was that part of the *proscenium* or stage where the chorus used to dance. In the middle of it was placed the Λογειον or pulpit. The orchestra was semicircular, and surrounded with seats. In the Roman theatres it formed no part of the scene, but answered pretty nearly to the pit in our playhouses, being occupied with seats for senators, magistrates, vestals, and other persons of distinction. The actors never went down into the orchestra.

ORCHESTRINO, a modern musical instrument, so called by its inventor Poulleau. It was shaped like a piano-forte, had similar finger-keys, and its sounds were produced by the friction of a circular bow upon the strings. It imitated the tones of the violin, the viola, the violoncello, the viol d'amour, the double-bass, &c. The construction of the bow (of hair, &c.) is said to have been very curious and ingenious.

ORCHESTRION, a musical instrument invented by the Abbé Vogler about 1789. It was a kind of portable organ, about nine feet in height, breadth, and depth. Its power was that of an organ of sixteen feet pipe, and it had a mechanism to swell or to diminish all the sounds within its compass. Another instrument of the same name, invented in 1796, by Kunz, a Bohemian, consisted of a piano-forte, combined with some organ-stops.

ORCHIA LEX, instituted by Orchius the tribune, in the year of Rome 566. Its intention was to limit the number of guests who were to be admitted at an entertainment; and it is also provided that, during supper, which was the principal meal amongst the Romans, the doors of every house should be left open.

ORCHILLA, or HORCHILLA, a small cluster of islands in the West Indies, situated not far from the coast of South America, in latitude 12. north, and longitude 65. 20. west. The largest island, which bears the form of a crescent, is very hilly on the east and west capes, and here trees and verdure abound; but the other parts are low, and the soil, from its flatness, is barren, and productive of very few plants. There is little fresh water, no animals except goats and lizards, nor does it appear to contain any permanent population. On the south-west side the shore is nearly as perpendicular as a wall, and the water being very deep, vessels can approach close to it without danger. Navigation is extremely difficult amongst the Orchillas; for not only are the islands separated from each other by very narrow channels, but there are a number of currents, variable, violent, and dangerous.

ORCHON, a river of Chinese Tartary, which has its rise on the confines on the great desert of Shamo, and falls into the Selingha. Long. 106. 14. E. Lat. 50. N.

ORCUS, the god of the infernal regions, was the same with Pluto, and so called from the Greek word ὄρχος, signifying a tomb or sepulchre; or from ὅρκος, an oath sworn by the river Styx. The ancients gave this name to all the divinities of the infernal regions, even to Cerberus. There was a river of the same name in Thessaly, which took its rise in the marshes of the Styx, and the waters of which were so thick that they floated like oil upon the surface of the river Peneus, into which they discharged themselves. This probably suggested to the poets the idea of the infernal abodes, which they denominated Orcus. Orcus has been confounded with Charon. He had a temple at Rome.

ORDEAL, an ancient form of trial. It consisted in an appeal to the immediate interposition of divine power, being particularly distinguished by the appellation of *judicium Dei;* and was sometimes called *purgatio vulgaris,* to distinguish it from the canonical purgation, which was by the oath of the party. Two kinds of this trial were more common than the rest, at least in Europe; viz. fire-ordeal and water-ordeal. The former was confined to persons of high rank, the latter to the common people. Both these might be performed by deputy; but the principal was bound to answer for the success of the trial, the deputy only venturing some corporal pain, for hire, or perhaps for friendship.

That the purgation by ordeal, of some kind or other, is very ancient, admits not of a doubt; and that it was universal in the times of superstitious ignorance, seems to be equally certain. It appears even to have been known to the ancient Greeks; for, in the *Antigone* of Sophocles, a person suspected by Creon of a misdemeanour, declares himself ready "to handle hot iron and to walk over fire," in order to manifest his innocence, which, the scholiast tells us, was then an usual mode of purgation. And Grotius gives many instances of water-ordeal in Bithynia, Sardinia, and other places. It seems, however, to have been carried to a greater height amongst the Hindus than ever it had been in any nation or amongst any people, however rude or barbarous; for in a paper in the Asiatic Researches, communicated by Mr Hastings, we find that the trial by ordeal amongst that people is conducted in nine different ways: firstly, by the balance; secondly, by fire; thirdly, by water; fourthly, by poison; fifthly, by the *cosha,* or the water in which an idol has been washed; sixthly, by rice; seventhly, by boiling oil; eighthly, by red-hot iron; and ninthly, by images.

1. Ordeal by the balance is thus performed. The beam having been previously adjusted, the cord fixed, and both scales made perfectly equiponderant, the person accused and a pundit fast a whole day; then, after the accused has been bathed in sacred water, the *homa* or oblation presented to fire, and the deities worshipped, he is carefully weighed; and when he is taken out of the scale, the pundits prostrate themselves before it, pronounce a certain *mentra* or incantation, agreeably to the Shastras, and, having written the substance of the accusation upon a piece of paper, bind it on his head. Six minutes afterwards they place him again in the scale, and if he weigh more than before, he is held guilty; if less, innocent; if exactly the same, he must be weighed a third time, when, as it is written in the *Mitacshera,* there will certainly be a difference in his weight. Should the balance, though well fixed, break down, this would be considered as a proof of his guilt.

2. For the fire-ordeal, an excavation, nine hands in length, two spans in breadth, and one span in depth, is made in the ground, and filled with a fire of pippal-wood. Into this the person accused must walk barefooted; and, if his foot be unhurt, they hold him blameless; but if it be burned, he is held guilty.[1]

3. Water-ordeal is performed by causing the person

[1] In Europe, fire-ordeal was performed either by taking up in the hand, unhurt, a piece of red-hot iron, of one, two, or three pounds eight; or else by walking, barefooted and blindfold, over nine red-hot ploughshares, laid lengthwise at unequal distances; and if the arty escaped unhurt, he was adjudged innocent; but if it happened otherwise, as without collusion it usually did, he was then ondemned as guilty. However, by this latter method, Queen Emma, the mother of Edward the Confessor, is mentioned to have eared her character, when suspected of familiarity with Alwyn, bishop of Winchester. The first account which we have of Christians ppealing to the fire-ordeal, as a proof of their innocence, is that of Simplicius, bishop of Autun, who lived in the fourth century. This relate, as the story is related, before his promotion to the episcopal order, had married a wife, who loved him tenderly, and who, nwilling to quit him after his advancement, continued to sleep in the same chamber with him. The sanctity of Simplicius suffered, least in the voice of fame, by the constancy of his wife's affection; and it was rumoured about that the holy man, though a bishop, ersisted, in opposition to the ecclesiastical canons, to taste the sweets of matrimony; upon which his wife, in the presence of a great ncourse of people, took up a considerable quantity of burning coals, which she held in her clothes, and applied to her breasts, with-ut the least hurt to her person or her garments, as the legend says; and her example being followed by her husband with similar ccess, the credulous multitude admired the miracle, and proclaimed the innocence of the loving pair. A similar trick was played St Brice, in the fifth century. (Mosheim, *Ecclesiast. Hist.* vol. ii.)

accused to stand in a depth of water, either flowing or stagnant, sufficient to reach his navel; but care should be taken that no ravenous animal be in it, and that it be not moved by much air. A Brahmin is then directed to go into the water, holding a staff in his hand; and a soldier shoots three arrows upon dry ground from a bow of cane. A man is next despatched to bring the arrow which has been shot farthest; and, after he has taken it up, another is ordered to run from the edge of the water; at which instant the person accused is told to grasp the foot or the staff of the Brahmin, who stands near him in the water, and immediately to dive into it. He must remain under water till the two men who went to fetch the arrows have returned; for, if he raise his head or body above the surface before the arrows are brought back, his guilt is considered as fully proved. In the villages near Benares, it is the practice for the person who is to be tried by this kind of ordeal to stand in water up to his navel, and then, holding the foot of a Brahmin, to dive under it as long as a man can walk fifty paces very gently; if, before the man has walked thus far, the accused rise above the water, he is condemned; but if not, he is acquitted.

4. There are two sorts of trial by poison. Firstly, the pundits having performed their homa, and the person accused his ablution, two *rettis* and a half, or seven barley-corns of *vishanaga*, a poisonous root, or of *sauc'hya*, that is, white arsenic, are mixed in eight *mashas*, or sixty-four *rettis*, of clarified butter, which the accused must eat from the hand of a Brahmin. If the poison produce no visible effect, he is absolved; but if otherwise, he is condemned. Secondly, the hooded snake, called *nagga*, is thrown into a deep earthen pot, into which is dropped a ring, a seal, or a coin. This the person accused is ordered to take out with his hand; and, if the serpent bite him, he is pronounced guilty; but if not, he is declared innocent.

5. Trial by the cosha is as follows. The accused is made to drink three draughts of the water in which the images of the sun, of Devi, and other deities, have been washed for that purpose; and if, within fourteen days, he has any sickness or indisposition, his crime is considered as proved.

6. When several persons are suspected of theft, some dry rice is weighed with the sacred stone called *salgram*, or certain *slocas* are read over it; after which the suspected persons are severally ordered to chew a quantity of it. As soon as they have chewed it, they are to throw on it some leaves of *pippal*, or, if none be at hand, some *b'hurja patra*, or bark of a tree from Nepaul or Cashmere. The man from whose mouth the rice comes dry or stained with blood is held guilty; the rest are acquitted.

7. The ordeal by hot oil is exceedingly simple. When it is heated sufficiently, the accused thrusts his hand into it; and, if he be not burned, he is held innocent.

8. In the same manner they make an iron ball, or the head of a lance, red hot, and place it in the hands of the person accused, who, if it burn him not, is judged guiltless.

9. To perform the ordeal by *dharmach*, which is the name of the *sloca* appropriated to this mode of trial, either an image, named *dharma*, or the genius of justice, is made of silver, and another, called *adharma*, of clay or iron, both of which are thrown into a large earthen jar; and the accused having thrust his hand into it, is acquitted if he bring out the silver image, but condemned if he draw forth the iron. Or, one figure of a deity is painted on white cloth, and another on black; the first of which they name *dharma*, and the second *adharma*. These are severally rolled up in cow-dung, and thrown into a large jar, without having ever been shown to the accused, who must put his hand into the jar, and is acquitted or convicted according as he draws out the figure on white or on black cloth.

The superstitious weakness of mankind, when left to themselves, is astonishing. There is indeed nothing so absurd that they may not be made most firmly to believe, nothing so impious that they will not do. Nor can a more notorious instance of the truth of this assertion be possibly given than that of the trial by ordeal. The gross absurdity as well as impiety of pronouncing a man guilty unless he was cleared by a miracle, and of expecting that all the powers of nature should be suspended by an immediate interposition of Providence to save the innocent, when it was even presumptuously required, is self-evident. Yet the origin of this mode of trial may be traced to necessity as well as to superstition. At the time in which it originated in England, as well as in other countries of Europe, it was no easy matter for an innocent person, when accused of guilt, to get himself cleared by the then established mode of trial. It was therefore natural for superstition to fly to Heaven for those testimonies of innocence which the absurdity of human laws often prevented men from obtaining in the ordinary course of affairs. In this way, doubtless, did the trial by ordeal commence; and being thus begun by necessitous superstition, it was fostered by impious priestcraft and unjust power. During all the processes there was great room for collusion and deceit, and there can be no question but it was often practised; it could not, therefore, on any account, or in any case, be a sign of innocence or of guilt.

Besides the particular methods of trial which we have already mentioned, there were some few more common in European countries; as the judicial combat, the ordeal of the cross, and the ordeal of the corsned.

The judicial combat was well suited to the genius and spirit of fierce and warlike nations, and, as we might reasonably expect, formed one of the most ancient and universal modes of trial. We know that it was exceedingly common in Germany in very remote ages. It was also used in some countries on the Continent at a pretty early period; but it is not mentioned in any of the Anglo-Saxon laws, and it does not appear to have been much used in England until after the Conquest. It was so much the custom in the middle ages of Christianity to respect the cross even to superstition, that it would indeed have been wonderful if the same ignorant bigotry had not converted it into an ordeal; and accordingly we find it used for this purpose in so many different ways as almost to preclude description. In criminal trials, the judgment of the cross was commonly conducted in this manner. When the prisoner had declared his innocence upon oath, and appealed to the judgment of the cross, two sticks were prepared exactly like one another; the figure of the cross was cut on one of these sticks, and nothing on the other; each of them was then wrapped up in a quantity of fine white wool, and laid on the altar, or on the relics of the saints; after which a solemn prayer was offered up to God, that he would be pleased to discover, by evident signs, whether the prisoner was innocent or guilty. These solemnities being finished, a priest approached the altar, and took up one of the sticks, which was uncovered with much anxiety. If it was the stick marked with the cross, the prisoner was pronounced innocent; but if it was the other, he was declared guilty. When the judgment of the cross was appealed to in civil causes, the trial was usually conducted in this manner. The judges, parties, and all concerned, being assembled in a church, each of the parties chose a priest, the youngest and stoutest whom he could find, to be his representative in the trial. These representatives were then placed one on each side of some famous crucifix; and, at a signal given, they both at once stretched their arms at full length, so as to form a cross with their body. In this painful posture they continued to stand whilst divine service was performing; and the party whose representative dropped his arms first lost his cause.

The corsned, or the consecrated bread and cheese, was the ordeal to which the clergy commonly appealed when they were accused of any crimes; and in this they acted a very prudent part, as it was attended with no danger or inconvenience. This ordeal was performed in this manner. A piece of barley bread and a piece of cheese were laid upon the altar, over which a priest pronounced certain conjurations, and prayed with great fervency, that if the person accused was guilty, God would send his angel Gabriel to stop his throat, that he might not be able to swallow that bread and cheese. These prayers being ended, the culprit approached the altar, took up the bread and cheese, and began to eat it. If he swallowed freely, he was declared innocent; but if it stuck in his throat, and he could not swallow, which we may presume seldom or never happened, he was pronounced guilty.

Besides these, there were a variety of other ordeals practised in Christian countries, many of which retain the same names which were used amongst Pagans, and differ only as to the mode in which they were performed. In all nations of Christians where these trials were used, we find the clergy engaged in them. Indeed, in England, as late as the time of King John, we find grants to the bishops and clergy to use the *judicium ferri, aquæ, et ignis;* and, both in England and Sweden, the clergy presided at this trial, and it was only performed in the churches, or in other consecrated ground. "Non defuit illis operæ et laboris pretium," says Stiernhook; "semper enim ab ejusmodi judicio aliquid lucri sacerdotibus obveniebat." But, to give the canon law its due praise, we find it at a very early period declaring against trial by ordeal, or *vulgaris purgatio,* as being the work of the devil, "cum sit contra præceptum Domini, *Non tentabis Dominum Deum tuum.*" Upon this authority, though the canons themselves were of no validity in England, it was thought proper (as had been done in Denmark above a century before) to disuse and abolish this trial entirely in our courts of justice, by an act of parliament 3 Henry III. according to Sir Edward Coke, or rather by an order of the king in council.

It may still perhaps be a postulate with some in what manner the effects of these trials were evaded, and how it was possible to appear to do that which we know could not be really done without material injury to the persons concerned. On this subject Dr Henry observes, in reference to the ordeals in ancient Britain, that, if we suppose few or none escaped conviction who exposed themselves to those fiery trials, we shall be very much mistaken. "For the histories of those times contain innumerable examples of persons plunging their naked arms into boiling water, handling red-hot balls of iron, and walking upon burning ploughshares, without receiving the least injury. Many learned men have been much puzzled to account for this, and disposed to think that Providence graciously interposed, in a miraculous manner, for the preservation of injured innocence. But if we examine every circumstance of those fiery ordeals with due attention, we shall see sufficient reason to suspect that the whole was a gross imposition on the credulity of mankind. The accused person was committed wholly to the priest who was to perform the ceremony, three days before the trial, in which he had time enough to bargain with him for his deliverance, and give him instructions how to act his part. On the day of trial, no person was permitted to enter the church but the priest and the accused till after the iron was heated, when twelve friends of the accuser, and twelve of the accused, and no more, were admitted, and ranged along the wall on each side of the church, at a respectful distance. After the iron was taken out of the fire, several prayers were said; the accused drank a cup of holy water, and sprinkled his hand with it, which might take a considerable time if the priest was indulgent. The space of nine feet was measured by the accused himself with his own feet, and he would probably give but scanty measure. He was obliged only to touch one of the marks with the toe of his right foot, and allowed to stretch the other foot as far towards the other mark as he could, so that the conveyance was almost instantaneous. His hand was not immediately examined, but wrapped in a cloth prepared for that purpose three days. May we not, then, from all these precautions, suspect that those priests were in possession of some secret that secured the hand from the impressions of such a momentary touch of hot iron, or removed all appearance of these impressions in three days; and that they made use of this secret whenever they saw reason? What greatly strengthens these suspicions is, that we meet with no example of any champion of the church who suffered the least injury from the touch of hot iron in this ordeal; but when any one was so fool-hardy as to appeal to it, or to that of hot water, with a view to deprive the church of any of her possessions, he never failed to burn his fingers, and lose his cause."

To this we may add what the learned Beckmann[1] has stated concerning the imposition which was probably practised in the ordeal by fire. "I am not acquainted with every thing that concerns the trial by ordeal, when persons accused were obliged to prove their innocence by holding in their hands red-hot iron; but I am almost convinced that this was also a juggling trick of the popes, which they employed as might best suit their views. It is well known that this mode of exculpation was allowed only to weak persons, who were unfit to wield arms, and particularly to monks and ecclesiastics, to whom, for the sake of their security, that by single combat was forbidden. The trial itself took place in the church, entirely under the inspection of the clergy; mass was celebrated at the same time; the defendant and the iron were consecrated, by being sprinkled with holy water; the clergy made the iron hot themselves; and they used all these preparatives, as jugglers do many motions, only to divert the attention of the spectators. It was necessary that the accused person should remain at least three days and three nights under their immediate care, and continue as long after. They covered his hands both before and after the proof, sealed and unsealed the covering; the former, as they pretended, to prevent the hands from being prepared any how by art; the latter, to see if they were burned.

"Some artificial preparation was therefore known, else no precautions would have been necessary. It is highly probable, that during the first three days the preventive was applied to those persons whom they wished to appear innocent; and that the three days after the trial were requisite to let the hands resume their natural state. The sacred sealing secured them from the examination of presumptuous unbelievers; for, to determine whether the hands were burned, the last three days were certainly not wanted. When the ordeal was abolished, and this art rendered useless, the clergy no longer kept it a secret. In the thirteenth century, an account of it was published by Albertus Magnus, a Dominican monk.[2] If his receipt be

[1] Vol. iii. 297.

[2] In his work *De Mirabilibus Mundi*, at the end of his book *De Secretis Mulierum*, Amsterdam, 1702, 12mo, p. 100. "Experimentum mirabile quod facit hominem ire in ignem sine læsione, vel portare ignem vel ferrum ignitum sine læsione in manu. Recipe succum bismalvæ, et albumen ovi, et semen psylli et calcem, et pulveriza, et confice cum illo albumine ovi succum raphani; commisce; ex hac confectione illineas corpus tuum vel manum, et dimitte siccari, et postea iterum illineas, et post hoc poteris audacter sustinere ignem sine nocumento."

Order.

genuine, it seems to have consisted rather in covering the hands with a kind of paste than in hardening them. The sap of the *althæa* (marshmallow), the slimy seeds of the flea-bane, which is still used for stiffening by the hat-makers and silk-weavers, together with the white of an egg, were employed to make the paste adhere. And by these means the hands were as safe as if they had been secured by gloves.

"The use of this juggling trick is very old, and may be traced back to a Pagan origin. In the *Antigone* of Sophocles, the guards placed over the body of Polynices, which had been buried contrary to the orders of Creon, offered, in order to prove their innocence, to submit to any trial. We will, said they, take up red-hot iron in our hands, or walk through fire."

ORDER, in *Architecture*, is a system of the several members, ornaments, and proportions of columns and pilasters; or a regular arrangement of the projecting parts of a building, especially the column, so as to form one beautiful whole. See ARCHITECTURE.

ORDER is also used to signify a division or class of any thing. Thus the tribe of animals called *birds* is subdivided into orders.

ORDER, in *Rhetoric*, is the placing of each word and member of a sentence in such a manner as will most contribute to the force, beauty, or evidence of the whole; according to the genius and custom of different languages. With regard to order, we may observe in general, that, in English, the nearer we keep to the natural or grammatical order, so much the better; but in Latin we are to follow the use of the best writers, a joint regard being always had to the judgment of the ear, and the perspicuity of the sense, in both languages.

ORDER is also used to signify a class or division of the members of a state, with regard to assemblies, precedence, levees, and other circumstances.

ORDERS, by way of eminence, or *Holy ORDERS*, denote a character peculiar to ecclesiastics, by which they are set apart for the holy ministry.

In no reformed church are there more than three orders, namely, bishops, priests, and deacons. In the Roman Catholic church there are seven, exclusive of the episcopate, all of which the council of Trent enjoins to be received and believed, on pain of anathema. They are distinguished into petty, or secular orders; and major, or sacred orders.

ORDERS, the petty, or minor, are four; those of door-keeper, exorcist, reader, and acolyte. Persons in petty orders may marry without any dispensation. In effect, the petty orders are looked on as little other than formalities, and as degrees necessary to arrive at the higher orders. The Greeks disavow these petty orders, and pass immediately to the subdeaconate; and the reformed churches to the deaconate. Their rise Fleury dates in the time of the Emperor Justinian. There is no call nor benefice required for the four petty orders; and even a bastard may enjoy them without any dispensation, nor does a second marriage disqualify.

ORDERS, sacred, or major, are, as has already been observed, three, viz. those of deacon, priest, and bishop. The council of Trent, reviving the ancient discipline, forbids any person being admitted to the major orders, unless he be in peaceable possession of a benefice sufficient for a decent subsistence, and allows no ordinations on patrimonies or pensions, except where the bishop judges it for the service of the church. A person is said to be promoted to orders *per saltum*, when he has not before passed the inferior orders. The council of Constantinople forbids any bishop being ordained without passing all the degrees; yet ecclesiastical history furnishes us with instances of bishops consecrated without having passed the order of priesthood; and Panormus still thinks that such an ordination is valid.

Military ORDERS are companies of knights, instituted by kings and princes, either for defence of the faith, or to confer marks of honour and grant distinctions to meritorious subjects.

Religious ORDERS are congregations or societies of monastics, living under the same superior, in the same manner, and wearing the same habit. Religious orders may be reduced to five kinds, namely, monks, canons, knights, mendicants, and regular clerks. Father Mabillon shows, that till the ninth century, almost all the monasteries in Europe followed the rule of St Benedict; that the distinction of orders did not commence till after the reunion of several monasteries into one congregation; that St Odo, abbot of Cluny, first began this reunion, bringing several houses under the dependence of Cluny; and that, a little afterwards, in the eleventh century, the Camaldulians arose, then the congregation of Vallombrosa, the Cistercians, Carthusians, Augustines, and at last, in the thirteenth century, the Mendicants. He adds, that Lupus Servatus, abbot of Terrières, in the ninth century, is the first who seems to distinguish the order of St Benedict from the rest, and to speak of it as a particular order.

White ORDER denoted the order of regular canons of St Augustin.

Black ORDER denoted the order of Benedictines.

These names were at first given to the two orders in question, from the colour of their habit; but were disused after the institution of several other orders, who adopted the same colours.

Gray ORDER was the ancient name of the Cistercians; but, since the change of the habit, the name is no longer applicable.

ORDERS, religious military, are those instituted in defence of the faith, and privileged to say mass; but who are prohibited marriage, and subjected to other restraints.

Of this kind were the knights of Malta, or of St John of Jerusalem, the Knights Templars, the knights of Calatrava, the knights of St Lazarus, the Teutonic knights, and various others.

ORDINAL NUMBERS, those which express order, as 1st, 2d, 3d, 4th, and so on.

ORDINANCE, or ORDONNANCE, means a law, statute, or command of a sovereign or superior. Thus the acts of parliament are sometimes termed "ordinances of parliament," as in the parliament rolls; although in some cases we find a difference made between the two, ordinances being only temporary things, by way of prohibition, and capable of being altered by the commons alone, whereas an act is a perpetual law, and cannot be altered except by king, lords, and commons.

Coke asserts, that an ordinance of parliament differs from an act, as the latter can only be made by the three-fold consent of the estates; whereas the former may be made by one or two of the estates.

In the French jurisprudence, ordonnances are such laws as are established by the king's authority alone.

ORDINARY, in general, signifies common, usual. Thus, an ambassador, or envoy, in ordinary, is one sent to reside statedly, and for a number of years, at the court of some foreign prince or state, in order to keep up a good understanding, and watch over the interest of his own nation.

ORDINARY, in nautical language, denotes the establishment of the persons employed by government to take charge of the ships of war which are laid up in the several harbours adjacent to the royal dock-yards. These are principally composed of the warrant officers of the said ships, as the gunner, boatswain, carpenter, deputy-purser, and cook, with three servants. There is, besides, enrolled in the list of the ordinary, a crew of labourers, who pass from ship to ship occasionally, to pump, moor, remove, or clean them, whenever it is necessary.

The term *ordinary* is also applied sometimes to the ships themselves; and it is likewise used to distinguish the inferior sailors from the most expert and diligent. The latter are rated *able* on the navy books, and have higher pay than those who are rated as *ordinary.*

Ordinary *of Assizes* and *Sessions*, was a deputy of the bishop of the diocese, anciently appointed to give malefactors their neck-verses, and judge whether they read or not; to perform divine service for them, and assist in preparing them for death.

Ordinary *of Newgate*, is one who attends in ordinary upon the condemned malefactors in that prison, to prepare them for death, and who records the conduct and behaviour of such persons.

ORDINATES, in *Geometry* and *Conics*, are lines drawn from any point of the circumference of an ellipsis, or other conic section, perpendicularly across the axis, to the other side.

ORDINATION, the act of conferring holy orders, or of initiating a person into the priesthood, by prayer and the imposition of hands.

Ordination has always been esteemed a principal prerogative of bishops, and they still retain the function as a mark of spiritual sovereignty in their diocese. The ordination of bishops is properly called *consecration.* Ordination is one of the sacraments of the church of Rome. In the established church of Scotland, where there are no bishops, the power of ordination is lodged in the presbytery; and by the Independents, in the suffrage of the people.

ORDNANCE, a general name for all sorts of great guns used in war.

Master-General of the Ordnance is deemed the principal officer in the civil branch of the ordnance; yet he is always chosen from amongst the first generals in his majesty's service.

Lieutenant-General of the Ordnance receives all orders and warrants signed by the master-general, and from the other principal officers, and sees them duly executed; issues orders as the occasions of the state require; and gives directions for discharging the artillery when required at coronations, birth-days, signal victories, and other solemn occasions.

Surveyor-General of the Ordnance inspects the stores and provisions of war in the custody of the storekeeper, and sees that they are ranged and placed in such order as is most proper for their preservation.

Clerk of the Ordnance, an officer whose function is to record all orders and instructions given for the government of the office; all patents and grants; and the names of all officers, clerks, artificers, gunners, labourers, and the like.

Storekeeper of the Ordnance takes into his custody all his majesty's ordnance, munitions, and stores belonging thereto, and indents and puts them in legal security, after they have been surveyed by the surveyor-general, any part of which he must not deliver without a warrant signed by the proper officers.

Clerk of the Deliveries of the Ordnance draws all orders for delivery of any stores, and sees them duly executed.

Treasurer and Paymaster of the Ordnance receives and pays all moneys, both salaries and debentures, in and belonging to this office.

ORDONNANCE, in architecture, is the composition of a building, and the disposition of its parts, both with regard to the whole and to one another; or, as Mr Evelyn expresses it, determining the measure of what is assigned to the several apartments. Thus ordonnance is the judicious contrivance of the plan or mould; as when the court, hall, or other building or apartment, is neither too large nor too small, and that the court affords convenient light to the apartments around it, the hall is of a fit capacity to receive company, and the bed-chambers of a proper size. When these divisions are either too great or too small with respect to the whole, as where there is a large court to a little house, or a small hall to a magnificent palace, the fault is in the ordonnance.

Ordonnance, in *Painting*, is used for the disposition of the parts of a picture, either with regard to the whole piece or to the several parts, as the groups, masses, contrasts, and so forth.

ORE, a mineral body, partly or entirely composed of some metallic substance, in the natural state in which it exists in the earth. Metallic substances are found either native, that is, pure, and uncombined with other substances, or alloyed with other metals, or combined with oxygen or sulphur, or with acids. Thus it appears that metals exist in ores in four different states; in the metallic state, when they are either pure, or combined with each other, as in the state of alloy; in the state of an oxide; combined with sulphur in the state of sulphuret; and, with acids, forming salts.

OREEHOUA, one of the smaller Sandwich Islands, which is a single high hummock, and is only separated from Onehow by a channel about a mile in width. The population is 4000.

OREGON Territory, a vast extent of country belonging to the United States of North America, and situated to the west of the Rocky Mountains. It is bounded on the north by the British and Russian possessions, the limits of neither power having been very clearly fixed. On the west it is bounded by the Pacific; on the south by Mexico; and on the east by the stupendous ridges of the Rocky Mountains, situated in the territories of Arkansas and Missouri. It may be assumed as stretching between the forty-first and fifty-fourth parallels of north latitude, and the thirty-fourth and forty-eighth meridians of west longitude. The waters which rise on the western declivities of the gigantic mountain chain bounding Oregon on the east, flow into the Columbia, the Multnomah, and the lake Buene-ventura. In general the elevated summits of the Rocky Mountains rise above the line of perpetual congelation. Beyond the mountains the country descends by regular belts, in the form of immense terraces, or descending plains, disposed regularly, the one below the other. Beyond the first plain, and between the Rocky Mountains and the Pacific, is another extensive and high chain of mountains, in which are the great falls of the Columbia; still farther to the west, running parallel with the coast, and at the distance of one hundred and fifty miles, is the third and last chain. The peaks of all these mountain ridges are covered with perpetual snow. The loftiest of them have been named Mount Baker, Mount Regnier, Mount St Helens, Mount Hood, and Mount Jefferson.

The Columbia and its branches are the only rivers which have been explored to any extent in the region of Oregon. This noble river, sometimes named after the territory, has its head waters near those of the Missouri, and it collects innumerable tributary streams throughout a great extent along the western ridges of the Rocky Mountains. Immediately after it emerges from these, its current becomes broad and deep, and having received Clarke's and Lewis' Rivers, which flow into it on the south-east side, its breadth is enlarged to nine hundred and sixty yards. It there takes a great bend to the south, and penetrates the second mountain barrier. One hundred and thirty-six miles lower down are the great falls, where the river descends fifty-seven feet in one rapid; but none of the cataracts singly are above twenty feet. Below these falls it winds first to the north-west, and then to the south-west, and intersects the third chain of mountains, where it is again compressed to one hundred and fifty yards in breadth. Below this rapid, which is distant one hundred and eighty miles from the Pacific, it meets the tide, and from this point it has a broad estuary to the sea. Sixty miles below the rapids, the Wallamat or Multnomah, a large tributary, flows in from the north-east; and this river, together with those of Clarke and Lewis, constitute the three great tributary streams of the Columbia. Vessels of three hundred tons may reach the Multnomah, and large sloops may ascend as high as the tide. Above the rapids the navigation is good for sixty-five miles, when it is interrupted by the long narrows; and higher up it is also interrupted by falls, which renders about five miles of portage necessary to obviate these obstructions to navigation. The river at the narrows, for upwards of three miles, is compressed into a strait, not exceeding sixty or seventy yards in breadth, the whole of which is a succession of boiling whirlpools. The Columbia flows into the Pacific Ocean in latitude 46. 19. north, and longitude 123. 54. west; and although its main sources are estimated at only eight degrees of latitude from this, yet if we take into calculation its serpentine windings, its course cannot be less than fifteen hundred miles. The mouth of this great river is upwards of four miles wide, and, to the distance of thirty or forty miles from its entrance into the sea, it is, properly speaking, a mere estuary, indented by deep bays, so as to vary from three to seven miles in width. It is rendered extremely intricate and dangerous by shoals reaching nearly from shore to shore, on which at times the winds and currents produce foaming and tumultuous breakers. The river proper, however, is only about half a mile wide at its confluence with the sea, being narrowed by the contracting shores of the estuary. The entrance from the Pacific is bounded on the southern side by a flat sandy neck of land, stretching into the ocean, and commonly called Point Adams. The opposite or northern side is Cape Disappointment, a kind of peninsula, terminating in a steep knoll or promontory, crowned with a forest of pine-trees, and connected with the mainland by a low and narrow neck. The Columbia River is, for a considerable distance, seldom less than a mile in breadth; in some places it is from two to five miles wide, and in others it forms lakes of very considerable magnitude. The shores are generally bold and thickly wooded. Pine in all its varieties predominates, and is mixed with white oak, ash, beech, poplar, alder, crab, and cotton wood, with an undergrowth of briars and other shrubs. Up to the rapids the river is covered with numerous islands, from one to three miles in length, some of which present fine meadows, and others are well wooded. Sand banks also prevail, and these, being so large and high as to be laid bare at low water, materially obstruct the navigation of the river. In the neighbourhood of these the shores are generally low, and present some fine flat "bottoms" of meadow ground, bordered by a profusion of blackberry and other wild-fruit shrubs; in the deep and narrow parts of the channel the shores are bolder. The pine-tree declines considerably above the rapids, and is much more equally mixed with other trees, amongst which the hazel occasionally predominates. But in regard to size, the pine and the cedar are as gigantic at the very source of the Columbia as they are on the shores of the Pacific. The Columbia and its tributaries abound with the finest salmon, which seem in fact to constitute the principal article of food of the savages who inhabit the country to the west of the Rocky Mountains. Seals and other aquatic animals are likewise abundant in this river, and the skins, which are exported to China, constitute the chief article of trade. A number of the head streams of the Missouri interlock with the waters of this river, as Wisdom River with Clarke's of the Columbia; and Jefferson of the Missouri with Lewis's of the Columbia. Clarke's River has a course of between two and three hundred miles before it unites with the Columbia. Lewis's River is also a large and long tributary, receiving in its course the North Fork and Kooskooskee, and, after winding six hundred miles, it joins the Columbia by a mouth upwards of six hundred yards in width. The current is very rapid. Its waters are deep, of a white colour, and slightly tepid, in which respect Lewis River forms a marked contrast with the Columbia, the waters of which are quite clear and cool. The latter river at this place is upwards of one thousand yards wide, and the current descends at an even rate of about four miles an hour. The two most important rivers which join the Columbia below the rapids are, the Multnomah, which has been already mentioned, and the Coweliskee. The general course of the former is a little to the eastward of south. It runs through a low, well-wooded country, for upwards of sixty miles, when the navigation is interrupted by a considerable fall, above which the channel contracts, and the banks become higher and less wooded. The climate on the shores of this river is remarkably mild, and not so moist as it is on the coast. It possesses a rich and luxuriant soil, which yields an abundance of fruits and roots; and amongst other herbs the tobacco plant has been discovered, and found to be of excellent quality. The Indians here are of a pacific character. There are no noxious reptiles, and beaver, deer, and elk are plentiful. Indeed it is anticipated, that when Oregon shall become generally colonized, the country about the Wallamat will be rendered one of the most delightful districts to the westward of the Rocky Mountains. Little is known of the Coweliskee. It enters the Columbia from the northward, about half a day's journey below the Wallamat. Its banks are high and thickly wooded, but its current is much interrupted by rapids.

Little information has been obtained regarding the geological features of this vast expanse of country; but it is presumed that the western declivities of these mountains are of primitive formation. The territory must have an abrupt slope towards the Pacific, as it descends as much in six hundred miles to the west, as it does in one thousand five hundred miles to the east. The summits of the mountain ranges, being rugged rocks, the only covering of which is snow, that remains during the greater part of the year, are necessarily sterile; but these rocky chains embosom and shelter valleys of considerable fertility. The timber which clothes the mountains consists of pine, spruce, fir, and the other terebinthines. The terrace plains below have in general a fine soil, but they are very scantily furnished with timber, except on the banks of the rivers. The prairies are covered with grass and a profusion of beautiful flowers, the same as on the eastern sides of the mountains. Amongst the prairie plants are found various species of edible roots, which are used by the savages, in addition to the immense quantities of salmon, which constitute their staple article of food. Wild sage is not only a most abundant herb, but it grows to so large a size that it is used as the chief article of fuel on these extensive plains. Deep and thick forests of such evergreens as pine and hemlock stretch along the shore, and extend a considerable way into the interior; and altogether it appears that the region which lies between the Rocky Mountains and the Pacific Ocean possesses in many parts a fertile soil, besides enjoying an agreeable climate. Its southern border, where it joins with Mexico, is indeed remarkably mild. In the year 1805 this region was explored by order of the American government; and from the tables which were drawn up by Lewis and Clarke, the persons employed on that service, a pretty correct idea may be formed of the meteorology, and consequently of the climate, of the country in question. From September it gradually became colder till the end of January, after which the rigour of the winter abated, and by the end of

February it was "quite warm." By the middle of March plants appeared above ground, and put forth their leaves; and on the 30th of that month, "grass was sixteen inches high in river bottoms." It is not, however, till the end of May that snow disappears from the high plains; and about the beginning of June the river Columbia is at its greatest height, being swelled by the melting of the snow on the mountains. Strawberries are ripe at the end of this month, and July and August appear to be the season when fruits and flowers arrive at full perfection. From other and more recent authorities we learn that the summer is reckoned temperate, the thermometer never rising above eighty degrees. Westerly winds prevail during the spring and early part of summer, and they are succeeded by fresh breezes from the north-west. In the month of October the southerly winds set in, bringing with them frequent rain. The rainy season, which commences in this month, continues, with little intermission, till April; and although the winters, as we have already observed, are mild, the mercury in the thermometer seldom sinking below the freezing point, yet the tempests of wind and rain are terrible. The sun is said to be sometimes obscured for weeks, the brooks swell into roaring torrents, and the country is threatened with a deluge.

The foregoing observations regarding the climate, soil, and productions of Oregon, apply chiefly to that part of the country which lies between the rapids and the Pacific Ocean. Mr Ross Cox, who spent several years in this region, informs us, that from the falls to the land of the Spokans, a distance of about five hundred miles, the summers are excessively hot, and the winters intensely cold, yet the climate is withal remarkably healthy, and, during these seasons, subject to but little variation. The soil is unproductive, consisting chiefly of a light yellowish sandy clay. The plains are covered with a short kind of grass, mixed with prickly pears, wormwood, and tufts of long, coarse grass, from three to five feet in height. Patches of clover are here and there visible, and in their vicinity the chappallel and the camas or quamash roots are found. Wild onions grow in considerable quantities along the banks of the river above the falls. Cotton wood, small willow, sumac, furze, and sarsaparilla, are also occasionally found; but from the falls to Spokan River, none of the larger trees are met with. The principal animals are horses, small deer, prairie wolves, red foxes, badgers, polecats, hares, and dogs. Otters are sometimes seen; but the great staple animal of the American trapper, the beaver, is a stranger to this particular district, whilst in other parts of the country it is frequently found. The Indians affirm that buffaloes were formerly numerous, but, together with the elk and the sheep, they have long since deserted the plains. No rattle-snakes are seen below the falls; but at a short distance above them they make their appearance, and are in some parts very numerous, as are also horned lizards and grasshoppers. Within the region of the Rocky Mountains vegetation on the Columbia is rich and luxuriant, including all the varieties, from a profuse growth of blackberry and wild cherry, to the stately pine and majestic cedar. On the eastern side of the mountains, the reverse of this is observed, vegetation being dwarfish and stunted. The difference is supposed to arise from the great humidity of the atmosphere on the Columbia. There, westerly and south-westerly winds prevail during eight months of the year, and are loaded with exhalations from the Pacific. Such of the clouds as are not arrested by the high lands on the coast, are stopped in their progress eastward by the lofty chain of the Rocky Mountains, and thus serve to keep the climate perpetually moist.

In the year 1811, a settlement was formed by American citizens at the mouth of the Columbia, and called Astoria, after Mr Astor, who conceived the idea of forming an extensive fur dépôt in this part of America. Astoria was taken by the British in 1813, and by them the name of the place was changed to that of Fort George. The soil and productions of this portion of the Oregon territory are thus described by Mr Ross Cox. "The soil in the valleys consists of a bed of rich black mould, about six inches in depth, which covers a stratum of gray earth, extremely cold. The latter lies on a layer of large gravelly sand; and under all is a bed of hard flinty stones. On the high grounds, under a thin covering of black mould, are found good quarry stones, well adapted for building. There is a bank of white earth, resembling chalk, to the southward of Point Adams; and farther on in the same direction, the Indians find red, green, and yellow earths, and a species of heavy shining clay resembling lead-mine. No limestone is found in the neighbourhood." In June there are, amongst other wild fruits, small white strawberries, of a sweet flavour; and these are followed by red and amber raspberries, which grow upon bushes from ten to fifteen feet in height. During the three months which follow, there are obtained considerable quantities of blueberries, blackberries, wild cherries, gooseberries, wild pears, and a species of bitter crab-apple. There is a shrub of a peculiar description, which yields a fruit much esteemed by the natives. The country likewise abounds in various nutritive roots, amongst which is a kind resembling young onions, collected by the Indians in great quantities, which, after being dried and pulverized, are made into loaves, and laid up for seasons of scarcity. The principal quadrupeds are the elk, the red deer, the black-tailed deer; the black, brown, and grizzly bear, the last of which is extremely ferocious; the wolf, lynx, panther, tiger-cat, wild cat, marmot, fox, beaver, land-otter, sea-otter, musk-rat, wood-rat, and the horse. White bears are occasionally killed on the coast to the northward of the Columbia, but they are scarce. The most remarkable of the feathered tribes are the black, brown, and nun eagle, the hawk, pelican, cormorant, swan, heron, crane, bustard, gray and white goose, various species of wild duck, and other water-game. In some parts, the humming-bird and bee, in great numbers, banquet during the summer months amongst the wild flowers and aromatic herbs. The trees most common in the neighbourhood of Astoria are the cedar, spruce, pine, alder, and some others equally valuable. The cedars are from twenty to thirty feet in circumference, and proportionally high. The alders also are extremely large; and ash and oak, the former of a tolerable size, are found a few leagues above the fort.

The rivers and the lakes are most abundantly furnished with fish of various kinds. In the spring months they swarm with immense quantities of small fish resembling pilchards, which are smoke-dried, and form an important article of barter with the upper Indians for roots. Prime sturgeon, which attains an enormous size, abound in the months of August and September; but the grand staple is salmon, the chief fishing of which is at the "long narrows," already mentioned, where the river, compressed into a channel from fifty to one hundred feet in breadth, boils and roars with great fury for a distance of three miles. In the spring of the year, when the water is high, the salmon ascend the river in incredible numbers. As they pass through this narrow strait, the Indians, standing upon the rocks, or on the end of wooden stages projecting from the banks, scoop them up with small nets distended on hoops, and attached to long handles, and cast them ashore. They are then cured and packed in a peculiar manner. After being disembowelled, they are exposed to the sun on scaffolds erected on the river-banks. When sufficiently dry, they are pounded fine between two stones, pressed into the smallest compass, and packed in baskets or bales of grass matting, about two feet in length and one in diameter, lined with the cured skin of a salmon. Packages are then made, each containing twelve of these bales, and being well wrapped up and secured, they are placed in dry situations, and again covered with matting. Each of these packages contains from ninety to a hundred pounds of dried fish, which in this state will keep sound for several years. At the head of the long narrows the Indians had some years ago, and have still, it is presumed, their principal trading mart or emporium. Here the salmon caught in the neighbouring rapids are "warehoused," to await customers. Hither the tribes from the mouth of the Columbia repair with the fish of the sea-coast, the roots, berries, and especially the wappatoo, gathered in the lower parts of the river, together with goods and trinkets obtained from the ships which visit the coast, or from the colonists. Hither also the tribes from the Rocky Mountains bring down horses, bear grass, quamash, and other commodities of the interior. The trade is of course pursued on the primitive principle of barter, the merchant fisherman acting as middleman or factor.

Although only a comparatively small portion of Oregon, and that chiefly situated on the banks of the great river, has been described, the greater part of the territory being still an unexplored wilderness, yet from this partial account we are induced to form a favourable opinion of the country. Wood appears to abound on the banks of the rivers, but many of the immense prairies of which the interior principally consists are nearly destitute of it, being chiefly covered with a coarse grass, and a prodigious growth of prickly pear, and other shrubs. Occasionally, however, there intervene bright green patches intermixed with wild flowers, and gently rising eminences, partially covered with clumps of small trees, which give an agreeable variety to the face of the country. Lewis and Clarke give a very pleasing account of what they term the great Columbian valley. It is sixty miles in width, and extends far to the south-south-east, between parallel ridges of mountains, which bound it on the east and west. Through the centre of this valley flows the Wallamat, which has already been described as traversing for several hundred miles a still unviolated wilderness. The sheltered situation of this immense valley has an obvious effect upon the climate, as might be expected. It is represented as a region of great beauty and luxuriance, with lakes, and pools, and green meadows, shaded by noble groves. Various Indian tribes are said to reside in this valley, and all along the banks of the Wallamat. There is another place called Oakinagan, of which Mr Ross Cox gives a very flattering description. It is a point of land three miles in length by two in breadth, formed by the confluence of the river Oakinagan with the Columbia. This small spot is enclosed at the upper end by a chain of hills, within which the rattlesnakes never intrude. The climate here is highly salubrious, the soil is fertile, producing immense quantities of sarsaparilla; the horses are abundant, and ample facilities exist for water-carriage. The native Indians who inhabit the peninsula are an honest, quiet, inoffensive tribe, whose chief occupation is catching and curing salmon, and hunting the deer and beaver. This was reckoned an eligible situation for a fort, and here one has accordingly been erected.

There is a district called New Caledonia, generally included in the territory of Oregon, of which a short account is requisite in this place. It extends from north latitude 51° 30′ to about 56°. The principal trading post is called Alexandria, which is built on the banks of Fraser's River, in latitude 53° north. The country in its immediate vicinity presents a beautiful and picturesque appearance. The banks of the river are somewhat low; but at a little distance inland, elevations, partially diversified by groves of fir and poplar, raise their heads above the general level. This region is full of small lakes, rivers, and marshes. It extends about ten days' journey in a north and north-east direction. To the south and south east the Atnah or Chin Indian country extends about one hundred miles; on the east there is a chain of lakes, and the mountains bordering Thompson's River; whilst to the westward and north-west lie the lands of the Naskotins and Clinches. The principal rivers are Fraser's, Quesnel's, Rough Poplar, Chilcotin, and West Road. Of these, Fraser's River only is navigable. It receives the waters of Quesnel's and West Poplar Rivers, which issue from small lakes to the westward. The lakes and rivers abound in fish, such as salmon, trout, sucker, and the like. The soil is thin and poor, and the vegetation here is considerably inferior to that on the Columbia. On the banks of the chief river, and in the interior, the trees consist of poplar, cypress, alder, cedar, birch, and different species of fir, spruce, and willow. There are some wild fruits, and edible and medicinal roots, but not at all so plentifully distributed as in other parts of the territory. A number of valuable minerals are found in New Caledonia, including coal in considerable quantities. There have also been discovered rock-crystal, cobalt, talc, iron, marcasites of a gold colour, marble and limestone, quartz and granite. The animal kingdom does not differ so much from that which characterises the banks of the Columbia, as to require specific mention. Spring commences in April, when the wild flowers begin to bud, and from this period to the latter end of May the weather is delightful. In June it rains incessantly, with strong southerly and easterly winds. During the months of July and August the heat is very great; and in September the fogs are so dense that it is quite impossible to distinguish the opposite side of the river any morning before ten o'clock. October gives indications of the approach of winter; and in January the cold is sometimes most intense. In general, however, the climate may be characterised as neither unhealthy nor unpleasant. The natives prosecute the salmon fishery to a considerable extent, and their mode of catching them is very similar to that already described. Large-sized sturgeon are occasionally taken, but this fish is not relished by the natives.

Of the various Indian tribes who still inhabit the immense tract of country which we have described, our limits permit us to present only a very brief notice. Their number has been estimated at about 140,000, and they are distributed into a great many tribes, which often engage in war with each other. Many of them are excellent hunters; and the mode of fishing and preparing the article for the market shows a practised ingenuity seldom evinced by the aborigines of America. There are striking contrarieties of character between the Indian tribes; some of them being pugnacious and bloodthirsty, and others of a comparatively mild and inoffensive disposition. Their diet and their mode of living also vary considerably, but they all chiefly subsist on the fish of the rivers, and the native roots of the soil. For some years a settlement of fur traders, called Astoria, has existed in Oregon. The chief intercourse of this place is with China. The question of settling this delightful country permanently has been more than once debated in Congress; and were such settlements authorized, and rendered secure by the requisite military establishments, there can be no doubt but it would receive large accessions of emigrants. This region is claimed by the United States, on the ground of priority of discovery, examination, and occupation. It was certainly first discovered by the Spaniards, but they made no attempt either to explore or settle it. Its rediscovery belongs to Gray, an American, who entered the mouth of the Columbia in 1790–1, the river being called after the ship which he commanded. Subsequently it has been explored by navigators belonging to Great Britain, as well as to the United States. (R. R. R.)

OREL, or Orlow, a government of Russia in Europe. It is situated in north latitude between 51. 49. and 54. 59. and in east longitude between 32. 49. and 38. 57., and extends over 16,610 square miles. It is divided into twelve circles, and contains 1,270,000 inhabitants. It is rather a level district, having no mountains, and only some ranges of chalk hills, between which are valleys and some woods, that render the face of the country more pleasing to view than most other parts of Russia. The rivers and rivulets are numerous, and empty themselves, some into the Wolga, and others into the Dnieper. The chief of the streams is the Desna, which arises in the province of Smolensko; and the next is the Oka, which originates in Kursk, and runs through the whole province. The soil is the most fruitful of any of the ancient divisions of Russia, and, though not well cultivated, yields crops of all the common grains, more than is required for domestic consumption. The surplus of corn, as well as spirits distilled from it, forms a branch of the export trade; but it is exceeded by the manufactured goods, which consist of linen, iron, and steel articles, raw hides and leather, tallow and soap, glass wares, hemp, flax, linseed oil, mats, butter, hams, and wool. The only mines are those of iron; but there are quarries of alabaster, and some yielding excellent millstones. Orel, the capital of the government, as well as of the circle in which it stands, is a city situated on the banks of the river Oka, at the spot where the Orlik joins that stream, and becomes navigable for barges. It is the seat of a bishop, and is surrounded by palisades, and protected by a citadel. It is a gloomy city, built chiefly of wood, and contains 2871 houses, with about 20,000 inhabitants, depending on the trade, which, from the whole province, centres in it. It is 732 miles from St Petersburg. Long. 35. 52. 2. E. Lat. 52. 56. 40. N.

ORELLANA, Francisco, the first European, as is commonly thought, who discovered the river Amazons. In 1539, he embarked, near Quito, upon the river Coca, which farther down takes the name of Napo. From this he fell in with another large river; and, leaving himself entirely to the direction of the current, he arrived at Cape North, on the coast of Guiana, after sailing nearly eighteen hundred leagues. Orellana perished ten years afterwards, with three vessels which had been intrusted to him in Spain, without being able to discover the mouth of this river. In sailing down the river, he met with some armed women, against whom an Indian cacique had told him to be on his guard; and he thence named it "the river of the Amazons."

ORENBURG, a government of Asiatic Russia, the most westerly of the whole, having on one side Russia in Europe, and on the other the government of Tobolsk. It is bounded on the south by Independent Tartary, and is traversed by the rude tribes of the Kirghisses and Kalmucks. The aspect of the country is mountainous, as it is intersected by the most elevated part of the great Uralian chain. Many parts are fertile, as the valleys and river banks, and yield grain, not merely for the subsistence of the natives, but for exportation. Numerous flocks and herds are fed on the abundant pastures; and even the camel is bred upon the plains. The breeding of bees is pursued with activity, and is found an extremely profitable branch of industry. A great quantity of large fish and caviar taken in the Ural are exported. This province is rich in mineral wealth. Its mountains afford inexhaustible mines of copper and iron; besides which, it contains saline lakes, which are very valuable. It is divided into twelve districts, of which the principal are Orenburg proper and Oufa, the last of which contains the capital. On the Tartar frontier this province is exposed to the incursions of the Kirghisses and the Kalmuck hordes, against which a chain of forts has been erected. The population is stated at 629,426.

Orenburg, the capital of the province above described until 1702, when the government was transferred to Oufa. It is a considerable town, of an oval form, situated in one of the extended plains of Russia, and regularly fortified. It was originally built higher up the Ural range, but in 1739 was transferred 120 miles lower, and in 1742 fifty miles more. It contains nine churches and 2000 houses. It carries on an extensive trade with Tartary, Bukharia, and all the countries in the interior of Asia. One great drawback on this trade is the insecurity of travelling across the vast intervening steppes, which are inhabited by nomadic tribes, who subsist by plunder. Were this obstacle removed (and the influence of the Russian government has gone far to remove it), the trade must greatly increase. The exports consist of cloths of different qualities, particularly of a red or scarlet colour, velvets, Russia leather, linens blue and white, copper and iron utensils, sugar and other colonial produce, toys, and glass, and various species of ornaments. From Tartary these caravans bring cotton wool, India muslins and cottons, Persian silks, a little gold dust, lapis lazuli, and a few precious stones. Sheep to the number of 40,000 or 60,000, and horses to the amount of 10,000, are brought annually to the market of Orenburg. The horses are sent to Russia, and also the sheep, the tallow of which is exported from St Petersburg. A considerable trade is carried on in the sale of golden eagles, which are highly valued by the Kirghisses. Long. 52. 31. 10. E. Lat. 51. 46. N.

ORENSE, a city of Spain, in the province of Galicia. It is situated in the higher part of the country, through which the Minho flows, over which there is a magnificent bridge. It was known to the Romans by the name of Aqua Calida, on account of three fountains of warm water which rise near it. It is situated in a very fertile district, which produces great quantities of wine; but, from the bad state of the roads, the expense of conveying it to a market is more than it would sell for when it arrived there. Orense is the see of a bishop, whose spiritual jurisdiction extends over a part of the contiguous province in Portugal. It possesses four churches, two monasteries, an hospital, and a population of 30,000 souls.

ORESTES, the only son of Agamemnon and Clytemnestra, was seven years old at the period of his father's murder, when he was saved by his sister Electra, who sent him secretly to Strophius, prince of Phocis, who had married the sister of Agamemnon. Here he was educated with Pylades the son of Strophius, and afterwards proceeded to Athens. Eight years after the murder of his father he returned to Mycenæ, and, with the assistance of Pylades and Electra, put to death Ægisthus and Clytemnestra (Hom. *Od.* i. 298; iii. 303–310; Hygin. 117). For this barbarous deed he was brought to trial, but was allowed to escape on account of his father. Tyndareus, father of Clytemnestra, was his accuser (Hygin. 119), or, according to another tradition, Perilaus, son of Icarius, and cousin of Clytemnestra (Paus. viii. 33, 2). He fled to Epirus, and there founded the city Argos Oresticon; but the district of Orestias is more properly in Macedonia (Strab. vii. 326). Suffering extremely from the stings of his conscience, he consulted the oracle of Delphi how he might best expiate his crime, when he was commanded to proceed to Tauris and to bring back the statue of Artemis or Diana Tauropolos. There was a law in that country that all strangers should be sacrificed to the goddess; and when Orestes and Pylades were found by some shepherds, they were brought to Thoas, king of Tauris, who ordered them to be delivered up to the priestess of Artemis, that they might be sacrificed. Iphigenia, the sister of Orestes, had been rescued from the altar when she was on the point of being sacrificed by orders of her father, and transferred by Artemis to be priestess in her temple in Tauris. Iphigenia

Orfa. discovered on inquiry that the strangers were her own brother and his friend, and assisted them in carrying off the statue (Hygin. 120). Upon their return they are said to have passed through Cappadocia, and to have instituted the worship of Artemis or Diana at Comena and Castabela (Strab. xii. 535, 537). Another tradition made him be expiated by the Trœzenian (Paus. ii. 31, 11). On the death of Menelaus, Orestes became king of Lacedæmon; and on the failure of the royal line of Megephenthes at Argos, he annexed that city to Mycenæ. He also acquired a great part of Arcadia, and was assisted by the Phocians (ii. 18, 5). In the latter part of his life he retired to Arcadia, and probably died by the bite of a serpent (Schol. Lycoph.) at Megea, whence his bones were afterwards transferred, in the reign of Anaxandrides, to Sparta (iii. 11, 8; Herodot. i. 67). He was married to Hermione, daughter of Menelaus and Helen, by whom he had Tisamenos, who succeeded him (Hygin. 122); and by Erigone, daughter of Ægisthus and Clytemnestra, he had Penthilus (Schol. Lycoph. 1374).

ORFA, or OURFA, a pachalik or division of Asiatic Turkey. It is almost entirely formed by the windings of the Euphrates and the river Khabour, and occupies a considerable portion of the most barren part of Mesopotamia. It touches on the north and east the pachalik of Diarbekir, and the dependencies of Malatea; and on the south and west it is separated by the Euphrates from the deserts of Syria. The southern part of this province is, for the most part, flat, sandy, and uncultivated, and inhabited by tribes of wandering Arabs, who pitch their tents on the banks of the rivers and in the vicinity of the springs; but towards the north the country is mountainous and better inhabited. In the early ages of the Roman empire this division of Mesopotamia bore the name of Osrhoene, and had subsisted for 840 years as an independent kingdom, when it was reduced into the form of a Roman province by the Emperor Caracalla. It was finally swallowed up in the Turkish empire. The principal towns are Orfa, Racca, and Soverick.

ORFA, a large town, and the capital of a pachalik of the same name, in Asiatic Turkey. It is situated on the eastern side of a hill, at the commencement of a plain; so that whilst its western extremity stands on elevated ground, the eastern quarter of the town stands on a lower level; and, with some trifling inequalities, the whole town may be said to be nearly flat. It is surrounded by a stone wall, which encloses a circuit of from three to four miles, in the form of an irregular triangle; and it is bounded on the west by modern burying-grounds, gardens, hills, and vales, on the south by a rising ground, on the east and south-east by a fertile plain, terminating at the foot of a bare ridge of hills, and on the south-west is a hill nearly overlooking the town, and crowned with the walls of a ruined castle. The houses are well built, and of good masonry; they have mostly a small door of entrance from the street, with an open court, and divans in recesses below, whilst the upper story is laid out in public rooms more expensively furnished. Above is the terrace, on which are placed sofas and beds, where, in hot weather, the family sleeps. The streets are narrow, but having a paved causeway on each side, with a central channel for water, and being more or less sloping downwards, are generally clean. The bazaars are numerous and well supplied, and are appropriated to the manufacture and sale of particular commodities. Most of these are commodious; they are also covered, and are always fresh and cool, being sheltered both from the sun and rains. The bazaar in which muslins, cottons, and other piece goods are exposed, is from twenty to twenty-five feet in width, and from thirty to forty feet in height, covered in by a range of fine domes in succession, admitting light and air by a sort of lantern windows in the roof. The khans and caravanserais are numerous, and some few are excellent. The Khan Khoolah-Oghlee, on the outskirts of the town, is spacious, and capable of accommodating in its central court 100 camels with their lading, in the adjoining stables as many horses, mules, and asses, and in the chambers above there is room for 200 persons. The Khan-el-Goomrook, or the custom-house khan, consists of an open court 100 feet square, and paved throughout. Through this court runs a fine broad stream of transparent water, crossing it diagonally, and serving for the watering of horses, the ablutions of the pious, and the washing and cleaning of manufactures. There are, above and below, about 100 chambers large enough to accommodate eight or ten persons each. There are fifteen mosques crowned with minarets. The most magnificent of these, though not the largest, is that of Ibrahim el Khaleel, or the mosque of the patriarch. It is situated on a lake filled from a clear spring which runs in the south-west quarter of the town, and abounds with fine carp, in which the superstitious people believe that, owing to the care of the patriarch, no impression can be made by any process of cooking. The grand façade of this mosque is a square pile of building, over which rise three large domes of equal size; and a lofty minaret springs up from amidst a cluster of tall cypress trees. At each end of this central pile, towards the stream, are flights of steps descending to the water's edge, for the ablutions of the pious. The wings are terminated by two solid masses of building, uniform in design, and "completing," says Buckingham, "one of the most regular edifices of this kind to be found perhaps in Turkey." The largest of the mosques at Orfa has a square steeple, and this form is also repeated in one of the smaller ones. The castle is on the south side of the city; the ascent is very steep, and is about half a mile in circumference, surrounded by a deep ditch cut in the rock, which can be filled with water from the river Scirtus. On this rock are the ruins of a building called by the Arabs the palace of Nimrod, consisting of two lofty and fine Corinthian pillars, and of some subterranean apartments, apparently of great antiquity. There are four or five large baths, some reported to be good; but the one which was seen by Mr Buckingham was, though spacious, dirty and badly attended. The manufactures of the town are chiefly confined to articles of the first necessity, namely, to coarse woollen cloths, used for shirts and drawers, and, when printed, made into gowns for females, shawls for the head, and some other articles. The process used for printing cottons is tedious. A few carpets are made, of a very good quality, also silk bands and tapes, hair-cloth for sacks and bags, and every description of saddlery and smith's work, as well as of mason's work and carpentry. Cook-shops and coffee-houses abound everywhere; and, during all the summer, there is an abundant supply of solid ice brought down from the summits of Mount Taurus, and sold at present for a farthing a pound. It is the seat of a considerable inland trade, being a thoroughfare for caravans passing from Aleppo into the interior of Persia. The population may be estimated at 50,000, amongst whom are 2000 Christians and 500 Jews, the rest being all Mahommedans. The Christians are chiefly Armenians and Syrians, each of whom have a separate church, and live in a separate quarter.

Orfa is of great antiquity, and is considered by all the learned Jews and Mahommedans, and by Christian scholars, as the Ur of the Chaldees. It was the Edessa of the Greeks and Romans, and was frequently taken and retaken during the wars between the Persians and Romans. In the reign of Heraclius, about A. D. 637, Orfa was taken by the Saracens, and its walls levelled with the dust. It was retaken by Baldwin in 1097, who founded the first principality of the Franks or Latins. It was also taken by Genghis Khan about the year 1144, and thirty years afterwards by

Saladdin. It was sacked by the Moguls in the thirteenth century; and two centuries afterwards suffered the same calamity from the armies of Tamerlane. It was visited in 1544 by Tavernier, in 1738 by Pococke, who describes it as being in a flourishing state, and in 1766 by Niebuhr, who gives the same account of it. It is sixty-seven miles from Bir, and 232 from Diarbekir. Long. 38. 25. E. Lat. 36. 50. N.

ORFFYREUS'S WHEEL is a machine so called from its inventor, who asserted it to be a perpetual motion. This machine, according to the account given of it by s'Gravesande, in his *Œuvres Philosophiques*, consisted externally of a large circular wheel, or rather drum, twelve feet in diameter, and fourteen inches deep, being very light, as it was formed of an assemblage of deals, having the intervals between them covered with waxed cloth, to conceal the interior parts of it. The two extremities of an iron axis, on which it turned, rested on two supports. On giving a slight impulse to the wheel in either direction, its motion was gradually accelerated; so that after two or three revolutions it acquired so great a velocity as to make twenty-five or twenty-six turns in a minute. This rapid motion it actually preserved during the space of two months, in a chamber of the landgrave of Hesse, the door of which was kept locked, and sealed with the landgrave's own seal. At the end of that time, however, it was stopped, to prevent the wear of the materials. The professor, who had been an eye-witness of these circumstances, examined all the external parts of it, and was convinced that there could not be any communication between it and any neighbouring room. Orffyreus, however, was so incensed, or pretended to be so, that he broke the machine in pieces, and wrote upon the wall that it was the impertinent curiosity of Professor s'Gravesande which made him take this step.

ORFORD, a borough and market town of the county of Suffolk, and hundred of Plomsgate. It is a part of the parish of Sudborne, though separated from it, and stands at the confluence of the river Ore and Alde, ninety miles from London. Orford was a place of some trade till its harbour became chocked up. It has a mayor, recorder, twelve burgesses, and eight portmen, and returned two members to the House of Commons till 1832, when it was disfranchised. It is remarkable for the ruins of an ancient tower, which serves as a land-mark to vessels. It gives the title of baron to Earl Walpole. The population amounted in 1801 to 751, in 1811 to 737, in 1821 to 1119, and in 1831 to 1302.

ORGAL, amongst dyers, denotes the lees of wine dried.

ORGAN, in general, is an instrument or machine designed for the production of some certain action or operation; in which sense the mechanical powers, machines, and even the veins, arteries, nerves, muscles, and bones of the human body, may be called *organs*.

Organ.

ORGAN, by far the most noble and imposing of all musical instruments. It is quite inconsistent with the design and limits of this work for us to enter into all the details of the nature and structure of the organ. They would fill a volume, and require many illustrative plates. We shall, however, endeavour to give such a general idea of the nature of the instrument as may satisfy those readers who are not professionally interested in the subject; and we assure them that their own inspection of the mechanism of an organ (which is easily attained in every large town) will afford them more clear and satisfactory knowledge than hundreds of pages written in explanation of its construction. For minute details, we refer to *L'Art du Facteur d'Orgues*, by F. Bedos de Celles, published at Paris in 1766 and 1778, in folio, with 137 plates. This is considered, even now, as the best and most complete work on organ-building. It is a pity we have none such in the English language. See also the Abbé Vogler's German works upon organ-building, and G. Serassi's *Lettere sugli Organi*, printed at Bergamo in 1816; together with Reports of the French Institute upon M. Grenié's improvements on the organ. We suspect that the general want of improvement in organ-building in Great Britain may be traced to the absence of such works, and some others, in our own language, for the instruction of our organ-builders. This may also explain, in some degree, why almost all the best organs in England were constructed by foreigners. Recently, however, we are happy to perceive a spirit of emulation arising amongst our native organ-builders; and we have little doubt that the ingenuity and superior workmanship of British artisans will soon enable us to vie with, or excel, the best organ-builders of the Continent. But, to do this, we must cast aside all national prejudices as to organs, &c. and meet foreigners upon a fair and liberal ground of competition.

The earlier history of the organ is extremely obscure. A small and imperfect instrument, somewhat on the principle of the organ, may have been known to the ancients; but surely nothing like our great church-organ. We read of ancient *hydraulic* and *pneumatic* organs; but such distinction is so far erroneous, inasmuch as organ-pipes could not be made to sound by having *water* forced through them. The water must have been a moving power only, to impel the *wind* into the pipes. It would seem that the Greek and Latin terms ὄργανον and *organum*, translated by the English word *organ*, originally signified an instrument or machine of any kind, and were afterwards applied to musical instruments of all kinds. "*Organa dicuntur omnia instrumenta musicorum*," says St Augustin. Still later, according to St Isidore, these names, ὄργανον and *organum*, were applied to none but wind-instruments. In modern times the term organ, in a musical sense, came to signify only the instrument which we now know under that name. The passage in Eginhard's Annals which has been interpreted the sending of *an organ* by Constantine Copronymus to King Pepin in the year 757, may more probably mean "*various musical instruments*," since the words are, "*Constantinus Imperator Pipini regi multa misit munera, interque et organa*," &c. A writer of the sixteenth century has ventured to describe the supposed *organ* sent to King Pepin; and, by force of imagination, makes it out to have been a grand organ with pedals. In Luitprand's History (book vi. c. 2) there is a curious passage regarding an instrument sent to the Emperor Constantine in 950:—"Erat Regia ornata sumtuosissime, ibi ænea inaurata arbor ante ipsius imperatoris solium effulgebat, expansis magnum in modum ramis aereis atque inauratis; in his frequentissimæ variarum specierum aves arte confictæ, quarum singulæ speciei proprias voces cantusque emittebant, incredibili arte." In the second volume of Gerbert (*De Cantu et Musica Sacra*, plate xxviii.) will be found a representation of a tree of this kind with birds upon it. The Chronicle of Albericus adds to the singing of the birds before Constantine, "the roaring of enormous gilded artificial lions." (See Gerbert, vol. ii. p. 151.) That such birds can be made, is certain from Maillardet's beautiful little artificial bird, which started up out of a gold snuff-box, fluttered its wings, and sang with a pipe so clear and loud as to fill a large room. It would appear that, in the rude instruments called organs in the eleventh and twelfth centuries, the pipes were disposed in such a manner that every sound in its finger-key compass caused the fifth and the octave of that sound to be heard above it. Such a succession of fifths and octaves was called "organum," no doubt *par excellence*. From this and the old and extraordinary specimens of *Biscantus*, or *Discantus*, given by Gerbert and others, and alluded to in our article MUSIC (page 623), we are inclined to believe that the modern mixture-stops of the organ have originated. We leave the consideration of the ancient organs to antiquaries, and now proceed to the modern organ, which seems to have assumed something of its present form in the fifteenth century.

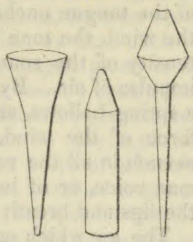
The mechanism of the modern organ has been much improved at different times by different builders. The family of the Antegnati, of Brescia, were amongst the earliest famous organ-builders in Italy in the fifteenth and sixteenth centuries. In the eighteenth century there were in Italy many celebrated organ-builders, amongst whom Serassi of Bergamo, and Callido of Venice, each constructed upwards of three hundred organs.

Most of our readers probably know already that the great organ is a complex wind-instrument, consisting of a great number of pipes of different sizes, formed of wood and of different kinds of metal, some of which are flute-pipes or mouth-pipes, and others reed-pipes; whilst all of these are made to sound by means of compressed air applied to them through certain channels, by bellows worked either by human force or by mechanism. There are different kinds of organs, from the Lilliputian bird-organ up to the great church-organ. We pass over the minor ones, including the chamber-organs and the smaller chapel-organs, and proceed to the great church-organ. We need not describe its front, nor the case in which its mechanism is contained. The great church-organ has usually three rows of finger-keys, placed above each other like steps. In some of the largest organs there are four, or even five such rows of keys. Besides these, there are rows of pedals, or foot-keys, which act upon the larger pipes of the organ. The bellows communicate, by a wind-trunk, with wind-chests, or reservoirs of air, whence the wind is distributed to the various pipes of the organ when the finger-keys or the foot-keys (pedals) are pressed down. Attached to the upper part of each wind-chest is a sound-board, as it is rather improperly called. This sound-board consists of two parts, an upper and an under board, the latter of which is much thicker than the other. Both of these are formed of planks of wood laid horizontally side by side, and accurately joined together at their edges. In the under side of the lower board several rectangular grooves or channels are cut parallel to each other, and carried along nearly the whole length of the board, and as far as there are stops in the organ. In these channels are fixed bars of wood, so as to render each channel or *partition* completely separate from every other. In the upper side of this board are cut a number of other rectangular channels or grooves running across the board, and at right angles with the under grooves. Into these upper grooves are exactly fitted wooden sliders, or registers, which run the whole length of the grooves. These sliders can be drawn out so far or pushed in at pleasure, by a mechanism attached to the draw-stops that are placed on the right and left in front of the organ. Holes corresponding with the number or rows of organ-pipes placed above the sound-board, are pierced through the latter into the above-mentioned channels, and also through the sliders or registers, in such a manner that when the latter are drawn out, their holes correspond with those of the sound-board, and allow the air from the wind-chest to pass through them and through the other holes in the sound-board; whilst, on the contrary, when the sliders are pushed in, they completely prevent any air from passing from the wind-chest to the pipes above the sound-board. Above all, and corresponding with the upper holes of the sound-board, are placed the pipes, fitted in by their conical feet to what are called the stock-boards. There are rows of thin boards, called racks, which are sustained by pillars of wood, and which receive the upper part of the feet of the pipes in holes made for the purpose. Opening into the wind-chest, and fixed upon the under side of the sound-board, are spring-valves, which are connected, by a particular mechanism, with the finger-keys and pedals; and which, when the sliders are drawn out, and the keys and pedals pressed down, are made to open, and so to admit the air from the wind-chest into the channels or partitions belonging to the different rows of pipes constituting the various stops of the organ. The pedals and the finger-keys communicate with these spring-valves by means of an apparatus of trackers, cranks, and rollers, acting upon pull-down wires that pass through the bottom of the wind-chest, and are attached to these valves. The draw-stop movement, by which the sliders are drawn out or pushed in, consists of a similar mechanism. In some organs these sliders are superseded by another contrivance. Thus, in what are called by the Italians *somieri a vento*, the opening of a given stop or register is not effected by drawing out a wooden slider, so as to make its apertures correspond with those in the sound-board; but by pulling open, all at once, in the channels of the sound-board, as many small valves as there are pipes to that given stop. These small valves are made to open by pulling out a draw-stop, and to shut by pushing it in again. They are considered to have many advantages over the ordinary slider, as being more durable, and less subject to the influence of changes of the weather.

A stop is called simple if it consists of one row of pipes, and compound if it consists of more than one row. As to the different rows of finger-keys, each communicates with what is really a separate organ, or collection of pipes, with its peculiar wind-trunk, wind-chest, sound-board, &c. These different organs are generally three, and are called the great organ, the choir-organ, and the swell-organ. The middle row of keys is connected with the great organ, the lower with the choir-organ, and the upper with the swell-organ. The swell-organ has its pipes enclosed in a wooden box furnished with a sliding door, or a hinged door, which is gradually opened or shut by mechanism moved by the performer's foot applied to a pedal. All these different organs, constituting the great church-organ, are supplied with air by the same bellows, and by suitable wind-trunks connected with the bellows. The bellows now generally used are horizontal ones, instead of the old ones resembling blacksmiths' bellows. For some improvements in the sound-board and its appurtenances, see Serassi's *Lettere sugli Organi*.

We have already mentioned, that the pipes of an organ generally consist of mouth-pipes and of reed-pipes. With regard to the mouth-pipes, their nature may be pretty well understood by any one acquainted with the upper part of the common English flute, or the flageolet. The reed-pipes are explained in a subsequent part of this article. What we have said regarding sonorous tubes in the article Music, pages 608, 613, 615, may assist the reader in understanding our notices of organ-pipes. Organ-pipes are either open, or stopped, or half-stopped. The stopped ones have a plug or tompion inserted into their upper end, and pushed down or pulled up to regulate the pitch. The half-stopped ones have a kind of chimney at the top. Some of the middle-sized ones are partly stopped, and have also on each side of the mouth a kind of ear of metal, by bending of which outwards or inwards, the pitch of the pipe may be regulated. The largest pipes are square ones of wood, and belong to the pedals. In some great organs, the largest open pipe is thirty-two feet in length. The other pipes are made of wood or of metal. It has been observed by organ-builders and others, that the quality of tone (*timbre*) of pipes depends much upon their proportions in length and width, the material of which they are made, &c.; and also upon the form of their open top, by which the wind escapes. We shall have occasion to notice this again, when describing some of Grenié's improvements. A reed-pipe, with a conical tube which has a bell-shaped end, as in fig. 1, gives the most brilliant sound. If the pipe have a reversed conical top, as in fig. 2, the sound becomes dull. If two similar truncated cones placed base to base be fixed to the wider end of a long conical tube, as in fig. 3, a reed-pipe so formed will give fulness and strength to the sound. Theory affords no satisfactory explanation of these facts. The *timbre* of the stopped and of the half-stopped pipes is softer and duller than that of the open ones. Pipes of pure tin have long been known to possess a *timbre* more clear and penetrating than those made of tin mixed with lead. Some years ago, a Bohemian organ-builder made some of his pipes of zinc, which was said to answer better than even tin. No doubt various simple and compound metals, and various other substances that have not yet been used in the making of organ-pipes, might be employed with advantage to produce a still greater variety of *timbres* and effects; and for the same purpose, various modifications of the ordinary forms of pipes might also be employed.

Fig. 1. Fig. 2. Fig. 3.

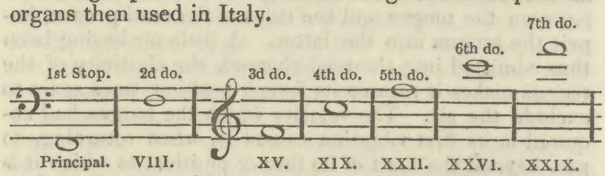


The pipes and stops of an organ differ in number and kind according to the size of the organ, the fancy of the builder, and the taste of the public. In some Dutch, German, and Italian organs, there seems to be a superfluity of stops. An immense organ at Weingarten, in Germany, is described as having sixty-six stops and 6666 pipes. The great organ at Haarlem contains sixty stops, and its largest pipe is thirty-two feet in length. For an enumeration of the stops of three of Silbermann's organs at Dresden, we refer to a Ramble among the Musicians of Germany, published at London in 1828 (pp. 193, 194, 195). One of the largest organs in Italy is said to be that built in 1733, by Azzolino della Ciaja, for the church of the Cavalieri di S. Stefano at Pisa. It is said to have four rows of finger-keys, and more than 100 stops. Another remarkable one is in the church of S. Alessandro in Colonna, at Bergamo. It was built by Serassi in 1782, and has three rows of finger-keys, and about 100 stops. In it the first and second rows of keys serve for the great organ, and the second organ or choir-organ, built together in the same part of the church. The third row of keys is connected with mechanism, which passes under ground and extends to a distance of about 115 feet English, with a third great organ placed in another part of the church, and directly opposite to the first. Notwithstanding such a distance from the keys, the third organ obeys them as readily as the first one does. Its lowest pedal-pipes consist not only of mouth-pipes, but also of reed-pipes. The following is a brief description of another organ built by Serassi in 1796. "Two rows of finger-keys, the upper for the great organ, the *ripieno* of which consists of the following stops: Two principal soprani; two principal basses; octave, twelfth, fifteenth, twenty-second, twenty-sixth, twenty-ninth, two thirty-thirds, two thirty-sixths, and twelve deep bass stops belonging to the chromatic scale, with the octaves of these, all, however, governed by one register. The different stops belonging to the great organ are, the sesquialtera; two cornets; flute in octave; flute in twelfth; German-flute; vox humana; viola; bassoon; English horn; trumpets; trombones; cymbals; kettle-drums, and bass-drum, the last being managed by a pedal. The lower row of manuals or finger-keys serves for the second organ, or choir-organ. It has its *ripieno*, composed of principal, octave, fifteenth, nineteenth, twenty-second, twenty-sixth, and twenty-ninth; and has, besides, the stops of cornet, flute in octave, vox humana, and violoncello. By means of a pedal moved by the right foot, all the stops of the first organ can be opened or shut at once."

Of the different stops or registers of an organ, some derive their names from the instrument the tone of which they imitate, and some from the relation in pitch which they bear to the sounds of the diapason stop, as octave, twelfth, fifteenth, seventeenth, and so on. We subjoin a brief account of the most usual organ-stops. I. *Open diapason;* consists of metal mouth-pipes open at the upper end, and extends through the whole scale of the organ, as its name diapason imports. II. *Stopped diapason;* mouth-pipes generally of wood, and their pitch an octave below that of the open diapason. They are stopped at the upper end. III. *Double diapason;* wooden mouth-pipes, open at the upper end, and their pitch an octave lower than those of the open diapason. They are generally confined to the two lowest octaves of the organ's compass. In some of the largest organs, the gravest sound of these is rendered by an open pipe thirty-two feet in length. IV. *Principal;* metal mouth-pipes, the pitch of which is an octave above the open diapason. The *principal* is the first stop tuned; and then, from it, all the other stops. V. *Dulciana;* a metal mouth-pipe stop, tuned in unison with the open diapason. The sweetness of its tone originates in the length and narrowness of its pipes. VI. *Twelfth;* metal mouth-pipes tuned a twelfth above the open diapason. VII. *Fifteenth;* metal mouth-pipes tuned an octave above the principal. There are, in some organs, stops named *tierce* or *seventeenth, larigot* or *nineteenth, twenty-second, twenty-sixth, twenty-ninth, thirty-third,* &c., tuned respectively at these intervals above the open diapason. VIII. *Flute;* metal and wood mouth-pipes, in unison with the *principal.* IX. *Trumpet;* reed-pipes of metal, in unison with the open diapason. X. *Clarion* or octave trumpet-stop; metal reed-pipes tuned an octave higher than those of the trumpet stop. XI. *Bassoon;* reed-pipes, in unison, as far as their compass reaches, with pipes of the open diapason. XII. *Cremona,* or properly *krum-horn;* reed-pipes, in unison with the open diapason. XIII. *Oboe;* reed-pipes, in unison with the open diapason. XIV. *Vox humana;* reed-pipes, in unison with the open diapason, and intended to imitate the human voice, a function which in general they perform very unpleasingly.

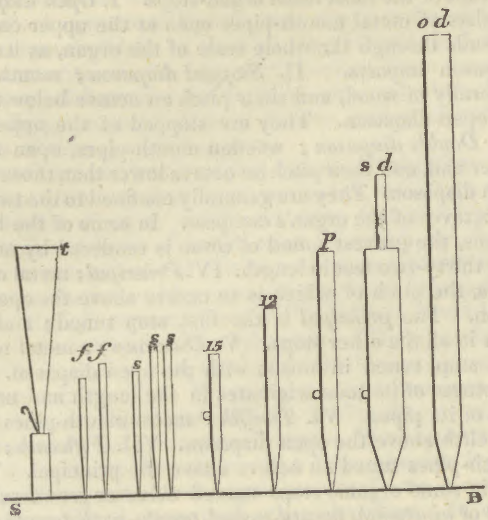
Amongst the *compound* stops used in organs are, I. The *sesquialtera,* consisting of four or five rows of open mouth-pipes at the intervals of seventeenth, nineteenth, twenty-second, twenty-fourth, or twenty-sixth, above the open diapason. II. The *cornet,* a stopped diapason, principal, twelfth, fifteenth, and seventeenth. III. *Mixture* or *furniture* stop, consists of several ranks of pipes nearly the same as those of the sesquialtera, but some of them of a higher pitch. Vogler denounces the *mixture-stops* as "*insignificant.*" We have sometimes heard a harsher term applied to them.

In Costanzo Antegnati's *Arte Organica* we find the following exposition of the series of registers or stops of the organs then used in Italy.



In order to enable the reader to form a clearer idea of the distribution of the pipes of an organ, we subjoin a sketch of a row of the usual pipes of the great organ (as contradistinguished from the choir and swell organs), and as these pipes stand upon and are inserted in the top of the sound-board. To simplify the diagram, the rack-board and pillars are not represented here. The letter *t* indicates the trumpet; *ff,* furniture; *sss,* sesquialter; 15, fifteenth; 12, twelfth; *p,* principal; *sd,* stopped diapason; *od,* open diapason; SB, the top of the sound-board. The other rows of pipes are, of course, to be imagined as placed behind those pipes here represented, and as extending, in their respective ranks, the whole length of each stop or register, in lines at right angles with the line formed by the row of pipes shown in the diagram.

Fig. 4.



Not many years ago, M. Grenié, a French amateur of music, introduced several important improvements in the construction of reeds for organ-pipes. (See the Reports of the French Institute, &c.) His reed (AB in the annexed figure 5) was made of wood or copper, square-edged, and of the form of a parallelopipedon. [In order to show the difference between the construction of M. Grenié's reed and the common organ-pipe reed, we add a diagram of the latter, fig. 6.] The tongue was a thin plate of brass, of an even surface, and cut in a rectangular shape, so as to fit almost exactly the grooved face of the reed. A strong wire-spring *cc* kept down this tongue firmly upon the reed, at the proper length, so as to regulate the tongue's vibrations. The result of such a construction is, that when this reed, enclosed in its tube, is made to sound by air forced into the porte-vent DEF, by the aperture at F, the air thus introduced not obtaining admittance into the reed between the tongue and the sides of the reed-groove, impels the tongue into the latter. A little air having been thus admitted into the reed-channel, the elasticity of the tongue makes it resume its former position, so as again to exclude the air. The velocity which the tongue had acquired in its first vibration causes it, when returning, to pass beyond the limit of its former position, to which it is again brought back by the resistance of the air, and by its own elasticity, and whence the impulse of the current of air from the porte-vent again forces it into the reed-channel. The advantages of this construction are, that the tongue does not strike against the edges of the reed, as in the common reed-pipes, which thereby produce a harsh and uneven tone; and that its movements are smooth and regular, since it has nothing to encounter in its vibrations but the air itself. The sound of M. Grenié's reed-pipes is said to be, in the most acute as well as in the gravest of them, as sweet and pure as that of flute-pipes. M. Grenié adapted the degree of strength and rigidity of each tongue to the breadth of the reed-channel which it

Fig. 5.

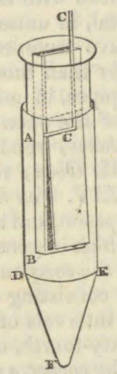
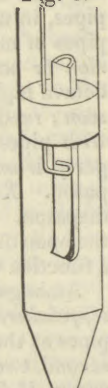


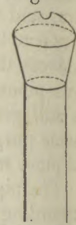
Fig. 6.



had to cover, so that the stream of air could never throw it into vibrations around its axis. The strength of the spring-wire also kept the length of the vibrating portion of the tongue unchanged; so that, whatever the force of the wind, the tone never altered its pitch. Only the intensity of the sound was affected by the greater or less impulse of air. By means of a pedal, the performer moved a spring-bellows, and, by thus regulating at pleasure the force of the wind, could obtain a *crescendo* and *diminuendo* in all the reed-pipes, as perfect as that of the human voice, or of instruments modified in their sounds by the lips and breath of the performer.

The air which causes these reeds to vibrate passes out through open pipes, bevelled off into a cone, and terminating in a hemisphere, fig. 7. This form is said to give roundness and strength to the tone.

Fig. 7.



M. Grenié, when constructing his reed-pipes, was for a long time checked by a very curious phenomenon. He was at first occupied with the gravest octave of which the sound C is in unison with an open flute-pipe of eight feet; and had constructed a certain number of pipes, in giving wind to all his reeds by pipes of the same length, fig. 8. But when he had reached the first notes of the tenor compass, still continuing to construct his porte-vents in the same manner, the reed would not sound at all. He in vain increased and diminished the wind, in vain lengthened and shortened the tongue; the reed remained mute, or produced only very bad sounds. At last, after many attempts, M. Grenié thought that the length of the pipe which conducts the wind to the reed might have some unknown influence upon its vibration. He therefore substituted for his fixed tubes two pipes, of which the one was made to slide within the other, so that he could gradually vary the whole length. He tried this change of length until the reed produced a clear, pure, and sustained sound. He found also, that in order to obtain the tenor sounds in all their fulness, it was necessary to make the porte-vent much longer than for the sound immediately preceding, and this length always went on diminishing for the most acute octaves, as is represented by fig. 9. Then the tops

Fig. 8.

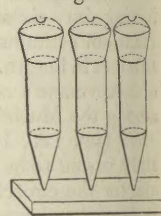
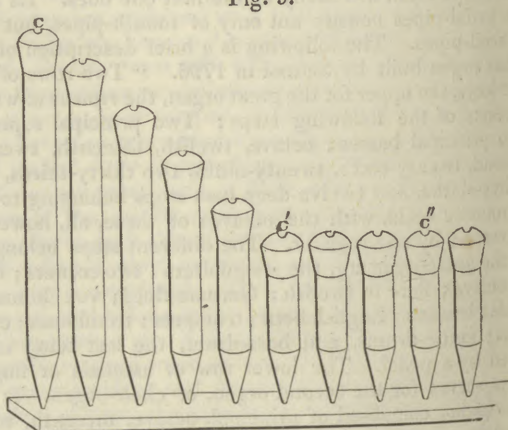


Fig. 9.



of the pipes formed the curve C C′ C″. This seemed to indicate that, by prolonging that curve, one would obtain the most favourable dimensions for those pipes of the first octave which M. Grenié had at first made of equal lengths. But, to his great surprise, he found that there was no advantage whatever in doing so; but that, on the contrary, the sounds became very dull and irregular. He therefore reasonably adhered to his first construction, which, nevertheless, he still purposed to improve, by afterwards making all his porte-vents sliding tubes, so that each of them might have the most favourable length given to it. He has since constructed, on this same model, open reed-pipes of sixteen feet, which sound with very remarkable distinctness, strength, and regularity. In this case the tongue is a flat slip of copper, in length 0·240 of a metre, in breadth 0·035 of a metre, in thickness 0·003 of a metre; equal respectively to 9·449040, and 1·377985, and 0·118113 English inches and decimal parts. Its vibrations are so powerful, that they cause the pipe in which it is placed, the porte-vent over which it is mounted, and all neighbouring elastic bodies, to tremble. Of course, in order to make it sound, a powerful and well-managed bellows-force is necessary. That which M. Grenié employed was perfect in regularity and power. It had a double current of air, and was worked by one handle. M. Grenié obtained a patent for his improvements. He considered the mixture-stops in common organs as productive of nothing but bad effects, and therefore excluded them from his organ. (See report by Cherubini, Catel, Baillot, &c. in 1811.) We have given so full an account of Grenié's improvements, in order to excite the attention of British organ-builders to this subject, and induce them to discover many more improvements of which our organs are unquestionably susceptible.

One of the greatest steps to improvement in English organ-building was made upwards of twenty years ago, by Messrs Flight and Robson of London, in the construction of their magnificent organ, called the Apollonicon. It was exhibited to the public, and attracted vast numbers of visitors. The ingenuity of its mechanism, the excellence of its workmanship, the fineness of its tone, and the novelty and grandeur of its effects, were universally acknowledged. This fine instrument was played either by means of the revolutions of three large cylinders, or else by means of six different sets of finger-keys acted upon simultaneously by six different performers. The Apollonicon was about twenty-four feet high and twenty broad. We heard it in 1817, and were much struck by its varied and powerful effects. However, the room in which it was placed was neither sufficiently large, nor so proportioned in form, as to display the powers of this organ to the best advantage. This fine instrument alone is sufficient to bear us out in what we have said at the beginning of this article, as to the certainty of English organ-builders being able to rival, or to excel, the foreign ones, if they choose to exert themselves.

Several methods have been proposed in England to render the intonation of the organ less imperfect, by dividing the octave into a greater number of intervals than the usual twelve: amongst others, that employed in Hawke's patent organ, described in the thirty-sixth and thirty-ninth volumes of the Philosophical Magazine. Hawke divided the octave into seventeen intervals. Loeschman's patent organ was another of this kind. He divided the octave into twenty-four intervals, which were produced by six pedals and twelve finger-keys. (See description in vols. xxxvii. xxxviii. of Philosophical Magazine.) In 1810, the Rev. Henry Liston, a clever and ingenious Scottish clergyman, obtained a patent for an instrument, constructed by Messrs Flight and Robson, which he named the *Euharmonic Organ.* (See vol. xxxvii. of Philosophical Magazine.) Another organ, similar to the one last mentioned, was made for Mr Liston by the same builders. (See Philosophical Magazine, vol. xxxix.) It had eleven pedals, six of which were the same as those in Loeschman's organ. In the second organ built for Mr Liston, there was a contrivance for an occasional alteration of the pitch of the pipes, in the requisite degree, by means of flat metallic plates, which, when acted upon by the pedals, were brought, at due distances, over the tops of the open pipes, or opposite to the mouths of the stopped pipes, so as to flatten the pitch when this change was required.

The object of Mr Liston's organ was to supersede temperament; but although its ingenuity and its effects were admired by many of the best musicians in London, the complexity of its manuals and pedals prevented it from ever being generally adopted. And this has been the fate of all such instruments, in modern as well as in ancient times; for attempts of a similar kind were made, centuries ago, to introduce such minute subdivisions of the octave into keyed instruments. The Spanish writer Salinas, in his work *De Musica* (lib. iii. c. 27), speaks disparagingly of an instrument called an Archicymbalum, which had been constructed in Italy above forty years before the publication of his work in 1577, and in which every tone was divided into five parts. "Non silentio prætermittendum arbitror instrumentum quoddam, quod in Italia, citra quadraginta annos fabricari cœptum est, ab ejus autore, quisquis ille fuit, Archicymbalum appellatum. In quo reperiuntur omnes toni in quinque partes divisi: ex quibus tres vindicat sibi semitonium majus, et duas semitonium minus, a quibusdam magni nominis musicis in pretio habitum, et usu receptum: eo quod omnis in eo sonus habet omnia intervalla, atque omnes consonantias (ut sibi videntur) inferne, et superne, et post certam periodum ad eundem, aut equivalentem sibi sonum post 31 intervalla reditur," &c. In the latter part of the last century, F. X. Richter, chapel-master in the cathedral of Strasburg, usually composed upon a clavichord, which had twenty-one sounds to the octave, and which then seemed to be upwards of two hundred years old. Richter died in 1789, aged eighty.

For some hints regarding the proper use of the organ, see the article Music (vol. xv. p. 644). Those who wish to extend their knowledge of this subject will find abundance of information upon the history and the construction of the organ, and the art of playing it, in works published in Germany, France, and Italy. The German works are the most numerous. (G. F. G.)

ORGANIST, a person who plays upon the organ. In Germany and Prussia, the requisites of a good organist are so many in point of musical education, and musical taste, and mechanical skill, that hardly any of the organists of other countries would venture to enter into competition with the German or Prussian organists. All the best works upon the art of organ-playing are in the German language. We may cite, as one of these, Rink's work upon organ-playing.

ORGANO-LYRICON, a musical instrument invented at Paris in 1810, by M. de Saint Pern. Its height is about eight feet two inches English, its breadth six feet six and a half inches, its depth about four feet four inches. It consists of a piano-forte, coupled with twelve different wind-instruments, viz. three kinds of flutes, an oboe, a clarinet, a bassoon, horns, trumpet, and fife. It has two rows of finger-keys. The lower row belongs to the piano-forte; but, by an ingenious mechanism, and according to the depression of the keys by the performer, it may be made to sound either the piano-forte alone, or a flute, or an oboe, or to unite them all. The upper row of finger-keys has no action on the piano-forte; but, by management of the pressure, it causes the German flute or the oboe to sound, and produces *rinforzi* by the gradual re-union of several wind-instruments. Independently of these functions, this row of finger-keys is destined for a great church-organ placed above it. The correspondence between the two rows of finger-keys is such, that they may, at the will of the performer, act together or separately, or even partially. The finger-keys are singularly light in their touch, even at their maximum of depression. At the bottom of the instrument there are pedals for the double bass, and for other combinations. The wind-chests are numerous, and of such capacity that the wind of the large bellows which fill them cannot produce in them any augmentation injurious to the purity of the *timbre* and the trueness of the intonation. In this instrument, by means of ingenious contrivances, the inconveniences of an irregular supply of wind have been carefully avoided. A double pedal for the right foot enables the performer to work the bellows himself when he is alone. An adjacent pedal, turned the opposite way, enables an assistant to do this. But, to avoid the trouble of these pedals, M. de Saint Pern placed in an adjoining room a large piece of clock-work, moved by a weight of fifty pounds, which served instead of a bellows-blower. The performer has beside him a mechanism that communicates with the clock-work, and, by means of a click and spring, leaves the weight going, or stops it at pleasure. See Report read to the French Institute on the 10th of September 1810; also Report of the French Conservatory of Music, 12th of August 1810, where it is said that "M. de Saint Pern's organo-lyricon might, in a large room or a chapel, hold the place of an orchestra, and imitate nearly all the effects of one."

ORGIA, feasts and sacrifices in honour of Bacchus, which were held every third year, and chiefly celebrated by wild, distracted women, called *Bacchæ*. The chief solemnities were performed in the night, to conceal, perhaps, their shocking impurities; and a mountain was generally chosen as the place of celebration. They were instituted by Orpheus, and from him are sometimes called *Orphica*. Authors are not agreed as to the derivation of the word; but if we consider the frantic proceedings of the Bacchanalians, ὀργη, *furor*, bids fair for being the true etymology.

Orgia, according to Servius, was a common name for all kinds of sacrifices amongst the Greeks, as *ceremoniæ* was amongst the Romans.

ORGUES, in the military art, are thick long pieces of wood, pointed at one end, and shod with iron, which being kept clear one of another, hang each by a particular rope or cord, perpendicularly, over the gateway of a strong place, to be let fall in case of the approach of an enemy.

Orgues is also used for a machine composed of several harquebuss or musket barrels bound together, by means of which several explosions are made at the same time. It is used to defend breaches and other places attacked.

ORGYA, ὀργυια, an ancient Grecian measure containing about six English feet.

ORIBASUS, a celebrated physician, greatly esteemed by the Emperor Julian, in whose reign he flourished. At the request of the emperor, he abridged the works of Galen, and of all the most respectable writers on physic; and he accompanied Julian into the East, but his skill proved ineffectual in the attempt to cure the fatal wound which his benefactor had received. After Julian's death he fell into the hands of the barbarians.

ORICHALCUM, or Aurichalcum, a metallic substance resembling gold in colour, but very inferior in value. It was well known to the Romans, who often took advantage of its resemblance to gold; for some sacrilegious characters, who could not resist the temptation of taking gold from temples and other public places, chose to conceal their guilt by replacing it with orichalcum. It was thus that Julius Cæsar acted when he robbed the capitol of three thousand pounds weight of gold; in which he was followed by Vitellius, who despoiled the temples of their gifts and ornaments, and replaced them with this inferior metal. It has been a matter of dispute with philosophers and others, what the composition of this metal could be, or how it was procured; it is probable, at least, that it was analogous to our brass, if not wholly the same with it.

The Romans were not only in possession of a metallic substance, called by them *orichalcum*, and resembling gold in colour, but they knew also the manner of making it; and the materials from which they made it were the very same with those from which we make brass. There are, indeed, authors of great repute who think very differently, and consider the art of making brass as an invention wholly modern. Thus M. Cronstedt does not think it just to conclude from old coins and other antiquities, that the making of brass was known in the most ancient times; and the authors of the French *Encyclopédie* assure us that our brass is a very recent invention. It appears, however, from Pliny (*Nat. Hist.* lib. xxxiv. § 2), and from the concurring testimony of other writers, that *orichalcum* was not a pure or original metal; but that its basis was copper, which the Romans changed into *orichalcum* by means of *cadmia*, a species of earth which they threw upon the copper, and which it absorbed. It has indeed been contended that the *cadmia* of Pliny was native arsenic; an opinion which scarcely merits confutation, but which must appear extremely groundless, when we reflect that it is impossible to make either brass or copper from arsenic, and that Pliny expressly calls the substance from which brass was made a *stone*. The testimony of Ambrose bishop of Milan in the fourth century, and of Primasius bishop of Adrumetum, in Africa, in the sixth, and of Isidorus bishop of Seville in the seventh, all seem to confirm Pliny's account. We may therefore safely conclude, that the Romans knew the method of making brass by mixing *cadmia* or *calamine* with copper. Yet it is probable they were not the inventors of this art, but borrowed it from some other country. It appears from a variety of testimonies that brass was made in Asia, in a manner similar to that employed at Rome; and a variety of places are mentioned where it was commonly made. It is supposed by some that in India, as well as in other parts of Asia, it was made in the remotest ages.

With respect to *orichalcum*, it is generally supposed that there were two sorts of this metal, one factitious, and the other natural. The factitious, whether we consider its qualities or its composition, appears to have been the same with our brass. As to the natural *orichalcum*, there is no impossibility in supposing that copper ore may have been so intimately blended with an ore of zinc, or of some other metallic substance, that the compound, when smelted, might yield a mixed metal of a paler hue than copper, and resembling the colour of gold or of silver.

We know of no country in which *orichalcum* is found at present; nor was it anywhere found in the age of Pliny, who does not seem to have known the country where it had ever been obtained. He admits, indeed, that it had been formerly dug out of the earth; but it is remarkable, that in the very passage where he mentions by name the countries most celebrated for the production of different kinds of copper, he only says in general, concerning *orichalcum*, that it had been found in other countries, but without specifying any particular country. Plato acknowledges that *orichalcum* was a thing only talked of even in his time; it was then nowhere to be met with, although in the island of Atlantis it had been formerly extracted from the mine. The Greeks were in possession of a metallic substance called *orichalcum* before the foundation of Rome. It is mentioned by Homer and by Hesiod, and by both of these poets in such a manner as shows that it was then held in great esteem. Other ancient writers have expressed themselves in similar terms of commendation; and it is principally from the circumstance of the high reputed value of *orichalcum* that authors have been induced to suppose that the ancient metal of this name was a natural substance, very different from the factitious one in use at Rome, and probably in Asia, and which, it has been shown, was in no respect different from our brass.

But this conclusion cannot be validly deduced from their encomiums upon *orichalcum;* for, at whatever time the method of making it was first discovered, its novelty and scarcity, joined to its utility, would enhance its value; at least there can be no absurdity in supposing, that when first introduced it was greatly prized, even though it be granted that it possessed no other properties than such as appertain to brass.

With respect to the etymology of the word there exists great diversity of opinions. Those who write it *aurichalcum* think it is composed of the Latin word *aurum*, gold, and the Greek χαλκος, *brass* or *copper*. But the most general opinion is that it is composed of ὄρος, *a mountain*, and χαλκος, *brass*, alluding perhaps to its being found in mountains or mountainous countries.

ORIENT, L', an arrondissement of the department of Morbihan, in France, which extends over 665 square miles. It comprehends eleven cantons, divided into fifty-two communes, and in 1836 it contained 133,307 inhabitants. The capital is the city of the same name. It is a fortified seaport, and a royal naval arsensal, standing at the mouth of the river Scorf, where it enters the bay of Port Louis. There are all those establishments for the building and equipping of ships of war. It is a well-built place, with long straight streets, and very fine quays. It has three churches, a naval hospital, 2000 houses, and 18,975 inhabitants. It is considerable also as a commercial port, is a dépôt for East India commodities, and has a great trade to the West Indies and the north of Europe. Long. 3. 30. W. Lat. 47. 48. 11. N.

Origen.

ORIGEN, a celebrated ecclesiastical writer, and one of the greatest geniuses, as well as most learned men, of the church, during the third century, was born at Alexandria in the year 185. He was surnamed *Adamantius*, either from his indefatigable application to study, or from the firmness he discovered amidst the torments which he suffered for the faith. Leonidas, his father, trained him with great care, and caused him, from his infancy, to apply to the study of the Scriptures, in which he made surprising progress. The son's inclination and turn of mind suited exactly with the father's design; for he pursued his studies with extraordinary zeal and ardour; and, being endowed with a quick apprehension and a strong imagination, he did not content himself with that sense which at first presented itself, but endeavoured to discover mysterious and allegorical explications of the sacred books. He would sometimes even puzzle his father, by soliciting the latter for recondite meanings; which obliged the good man to reprehend him a little, and withal to advise him not to attempt to penetrate too far in the study of the Scriptures, but to content himself with their clear, obvious, and natural sense. Hence it appears how early he was seized with that *furor allegoricus*, as a learned modern calls it, that rage of expounding the Scriptures allegorically, which afterwards became a distemper, and carried him to excesses which can never be excused. In philosophy he had the celebrated Ammonius as his teacher, and St Clement of Alexandria for his master in divinity. At eighteen years of age he succeeded the latter in the office of catechist; an important employment, which consisted in teaching divinity, and in expounding the Scriptures. Leonidas his father had suffered martyrdom the year before, during the persecution of Severus, in 202; and Origen had shown such eagerness to follow his father to martyrdom, that his mother was obliged to hide his clothes to prevent him going abroad. Origen had a great concourse of auditors who attended his school, some of whom were of the faithful, and the others Pagans. He confirmed and strengthened the former in their faith, and converted most of the latter; and there were such a number of martyrs amongst his disciples, that it might be said that he kept a school of martyrdom rather than one of divinity. He taught the doctrines of Christianity to the women and girls, as well as to the men; and taking in a too literal sense what Christ says of becoming voluntary eunuchs, castrated himself, to prevent his deserving or suffering scandal. He took a voyage to Rome in 211, in the beginning of the reign of Caracalla, under the pontificate of Zepherinus. On his return he published many works, whereby he acquired an extraordinary reputation, which drew to him a great number of auditors. But Demetrius, bishop of Alexandria, conceiving a jealousy of him, endeavoured upon various pretences to injure him. At length Origen went to Antioch, whither the Empress Mammæa had sent for him to hear him discourse on the Christian religion. He did not however stay long there, but returned to Alexandria, where he continued to teach till the year 228, when he left that city and travelled into Achaia. He then went into Palestine, and was ordained by the bishops of that province at forty-two years of age. But the circumstance of his being ordained by foreign bishops, without the permission of Demetrius, renewed that prelate's resentment against him; upon which Origen hastily returned to Alexandria, to endeavour to mollify him. Demetrius, however, drove him thence in the year 231, and caused him to be excommunicated, and even deposed, in a council which was held in Egypt. Origen then retired to Cæsarea in Palestine, where he raised a celebrated school, and had St Gregory Thaumaturgus, and a great number of other persons who were illustrious for their virtue and learning, as his disciples. He afterwards travelled to Athens, and, at the desire of Firmilianus, staid some time at Cæsarea in Cappadocia; whence he was invited into Arabia, to convince and bring back to the truth Beryllus bishop of Bostra, who maintained that the Word had no existence before his incarnation. Origen had the happiness to make him sensible of his mistake; and some years afterwards he was sent into Arabia by an assembly of bishops, to dispute against certain persons who maintained that the souls of the dead remained in a state of insensibility till the general resurrection. At length the seventh persecution of the Christians began in the reign of Decius, and none was treated with greater severity than Origen. He supported with incredible constancy the dreadful torments which the persecutors of the Christians invented against them; torments which were the more insupportable, as they were made to continue for a long time, and as the persecutors took the greatest care to prevent his expiring in the midst of his tortures. But in the most excruciating agony he discovered an heroic courage, and suffered nothing to escape him which was unworthy a disciple of Jesus Christ. Origen died at Tyre in the year 254, aged sixty-nine. He was the author of a great number of excellent works. The principal of those which have descended to us are, 1. A Treatise against Celsus, of which a good edition in Greek and Latin, with notes, has been published by Spencer; 2. A number of Homilies, with Commentaries on the Holy Scriptures; 3. Philocalia, and several other treatises; 4. Fragments of his Hexapla, collected by Montfaucon, in two volumes folio. Of all Origen's works, the loss of the Hexapla is most to be regretted. This work was thus named from its containing six columns, in the first of which was the Hebrew text of the Bible; in the second, the same text in Greek characters; in the third, the Greek version of the Septuagint; in the fourth, that of Aquila; in the fifth, that of Symmachus; and in the sixth, Theodosian's Greek version. This admirable work first suggested the idea of our Polyglot Bibles. Of the book of Principles we have only an incorrect Latin version. The most complete edition of the works of Origen is that of Father Delarue, a Benedictine, in Greek and Latin. Montfaucon likewise published, in two volumes folio, some remains and fragments of his Hexapla. He ought not to be confounded with another Origen, a Platonic philosopher, and the disciple and friend of Porphyry, who studied philosophy under Ammonius. This Origen was perhaps the founder of the sect of Origenians.

ORIGENIANS (*Origeniani*) were ancient heretics. Epiphanus speaks of them as existing in his time; but their numbers, he says, were inconsiderable. He seems to fix their rise about the time of the great Origen; but he does not say that they derived their name from that distinguished father of the church. On the contrary, he distinguishes them from the Origenists, whom he derives from *Origen Adamantius;* adding, that they first took their name from one Origen, by which he intimates that it was not the great Origen. St Augustin also asserts that their founder was a different person. Their doctrines were infamous. They rejected marriage; they used several apocryphal books, as the acts of St Andrew; and they endeavoured to excuse their open crimes, by saying that the Catholics committed the same in private.

ORIGENISTS, in *Ecclesiastical History*, a Christian sect in the fourth century, so called from their deriving their opinions from the writings of Origen. The Origenists maintained that the souls of men existed in a prior state; that they were holy intelligences, and had sinned in heaven before the body was created; that Christ is only the Son of God by adoption; that he has been successively united with all the angelical natures, and has been a cherub, a seraph, and all the celestial virtues one after another; that in future ages he will be crucified for the salvation of the devils, as he has already been for that of men; and that their punishment, and that of the damned, will continue only for a limited time.

ORIGINAL, a draught or design of any thing, which serves as a model to be imitated or copied.

Original Sin. See Theology.

ORILLON, in *Fortification*, a small rounding of earth, faced with a wall, and raised upon the shoulders of those bastions which have casemates, to cover the cannon in the retired flank, and prevent their being dismounted by the enemy.

ORINOCO, or Oronoko, a river of Colombia, in South America. Like all great rivers, its upper waters separate into several branches, and it does not appear that the main source has been ascertained with any degree of certainty. According to La Cruz d'Olmedilla, it issues from a small lake called Ypava, situated in north latitude 5° 5′, whence, by a bend of a spiral form, it enters the lake Parima; but although the existence of this sheet of water has been determined, doubts are entertained whether it may not owe its origin only to the temporary overflowings of the river. From this lake it is said to issue by two mouths; and after a very circuitous course of upwards of fifteen hundred miles, including its windings, it flows into the Atlantic Ocean, opposite to the island of Trinidad, by about fifty mouths, seven of which are navigable. The Grande Boca, or principal mouth, which is six leagues wide, is south-east of Trinidad, in latitude 8° 30′ north, and longitude 59° 50′ west. A soft mud bank, formed by the debris brought down by the river, and of course just an extension of the delta of the Orinoco, which will one day be clothed with vegetation, stretches a considerable way into the ocean on the left of the grand mouth, forming one line of the channel to the entrance of the river. The other side of this channel consists of hard ground, covered with shells and shingles, and on which the water deepens and shoals continually. At its estuary it presents the appearance of a boundless lake, and for a great extent its fresh waters penetrate into the bosom of the ocean, almost uncontaminated by saline matter. "Its green-coloured stream," says Humboldt, "and its waves dashing over rocks in milk-white foam, are strongly contrasted with the deep blue of the sea, which is separated from them by a strongly marked line." Such is the force of the stream formed by the Orinoco between the main land and the island of Trinidad, that vessels overcome it with great difficulty, even when favoured by a fresh breeze from the west. This solitary and dreadful place, perpetually tormented as if by a whirlpool, is called the Melancholy Gulf, the entrance to which is formed by the Dragon's Mouth. There, in the midst of furious waves, says the great traveller just quoted, enormous rocks raise their isolated heads, the remains of that ancient dike which formerly joined the island of Trinidad to the coast of Paria. It was the aspect of these places which first convinced Columbus of the existence of the continent of America. The unrivalled navigator reasoned admirably when he concluded that such an immense body of water must have accumulated during a very lengthened course, and that the country through which it flowed must be a continent, and not an island. He, however, supposed it to be a continuation of the coast of Asia; and, from the ethereal clearness of the sky, the refreshing mildness of the evening air, and the aromatic odours which came wafted by breezes from the land, the Orinoco appeared to him to be one of the four streams which issued from the terrestrial paradise to fructify and divide the earth, and he believed that he was about to set foot in the garden of Eden.

Within the bar of the Orinoco the water gradually deepens, the force of the current continuing very considerable, and sometimes during the rainy season running at the rate of six miles an hour, so that navigation upwards is exceedingly difficult, except by steam-boats. At some distance within the Grande Boca of the river there is an island very thickly wooded, and forming the segment of a large circle. Indeed the magnificence of the scenery on the banks of the Orinoco is the astonishment of every traveller. Forests of boundless extent expand on either side, and, being filled with aromatic herbs and flowers that diffuse the most delightful odours, and all alive with birds of beautiful and glancing plumage, from the lovely mocking-bird to the grand vulture and fiery-red flamingo, together with hordes of monkeys, which disport from bough to bough, exhibit a richness, grandeur, and variety of scene which defies description. Passing these forests, enormous plains stretch out like oceans of verdure, far beyond the horizon embraced by the eye; and the sublimity of the scenery on the Orinoco is enhanced by several cataracts, of which Humboldt has distinguished and described those of Maypures and Atures. Their elevation is inconsiderable, and both owe their existence to an archipelago of little islands and rocks. The appearance of these rapids, however, is exceedingly picturesque and beautiful. "When the traveller descends from the village of Maypures to the brink of the river, after clearing the rock of Manimi, he enjoys a truly astonishing prospect. At once a sheet of foam stretches out before him, to fully a mile in extent. Masses of rock, of an iron-black colour, rear their rugged fronts, like towers, out of this misty cloud. Every island, every rock, is ornamented with luxuriant trees, closely grouped together. A thick smoke constantly hangs suspended over the water; and through this foggy vapour, which rises from the foam, shoot up the tops of lofty palm-trees. As soon as the burning rays of the setting sun mingle with this humid cloud, the optical phenomena which are produced actually give an air of enchantment to the scene. The coloured arches successively appear and disappear, and their image incessantly hovers before the eye at the mercy of the wind. During the long season of the rains, the murmuring waters have accumulated little islands of vegetable earth round the naked rocks. Adorned with the drosera, the mimosa with its foliage of silver white, and a multitude of other plants, these form beds of flowers in the midst of frowning rocks."

The Orinoco is navigable, without difficulty, for two hundred and sixty leagues, to the rapids of Atures, where its mean height above the sea is, according to the traveller just quoted, not more than three hundred and fifty feet, and thence, after two short portages, for one hundred leagues more, to the point near Esmeraldo, where the celebrated bifurcation of this river takes place, and a portion of its waters descends along the natural Canal of Casiquiari, to join the Rio Negro and the Amazon. The communications which exist between the Orinoco and the Amazon constitute one of the most astonishing phenomena of physical geography. More than half a century has elapsed since the fact was made known by the Portuguese; but for a long period after this it was pertinaciously maintained by systematical geographers, that such conjunctions of rivers were impossible. By the enterprise and perseverance of recent travellers, however, it has been proved that this is no anomaly; and we no longer stand in need of either analogies or critical reasoning to support the fact. M. de Humboldt has navigated both these rivers, and examined and described this singular arrangement of the land. It is now put beyond a doubt, that the Orinoco and the Rio Negro flow along a plateau, which at this part has no actual acclivity. A valley then intervenes, their waters flow into it, and there unite, thus forming the celebrated Casiquiari, by means of which MM. Humboldt and Bonpland passed from the Rio Negro into the Orinoco. It is believed that there are also other communications between the Rio Negro and the different tributaries of the Amazon. On both sides along its course the Orinoco receives many tributary streams, of which three in particular, the Apure, the Meta, and the Guaviare, flowing from the westward, have also long navigable courses. The Apure falls into the Orinoco about four hundred and forty miles from the mouth of the latter river, in latitude 7. 36. 23. north, and longitude 69. 7. 29. west. The course of the Apure is as serpentine as that of the Orinoco, only on a much smaller scale, the tributary being in no part of its course much more than a musket-shot across. At rather more than one hundred miles from the confluence of the two rivers is San Fernando de Apure, a considerable town in the province of Apure, and a place of some commerce. From thence the navigation is continued, partly on the Apure and partly on the river Santo Domingo, to Toruno and Varinas, at a distance of above two hundred miles farther. The line of navigation of this branch of the commerce of the Orinoco extends, therefore, nearly eight hundred miles from the mouths of the river to the extremity of the province of Varinas. About sixty miles below the cataracts, the Orinoco receives the Meta, a river which, issuing from the paramos of Cundinamarca, keeps its course parallel to them for a hundred and fifty miles, receiving in its progress their tributary streams; and then bending to the east, crosses the llanos of Casanare, and completes a course of more than four hundred miles before its confluence with the great river.

At some future period the navigation of the Meta will become an object of very great importance to Guiana, and all the other eastern departments of the republic. The Guaviare is also a very considerable navigable river, formed by a number of streams which flow down the eastern declivities of the Andes. It joins the Orinoco at San Fernando de Atabapo, in latitude 4° 3′ north, and longitude 68° 10′ west, which is the point where the Orinoco takes a great bend to the north. When steam navigation shall have become common in this quarter of the world, the river Guaviare will prove of immense advantage to some of the interior provinces of Colombia, as a medium through which their produce may be conveyed to the sea-ports of the republic. There are a great number of other streams, tributary to the Orinoco, no less than three hundred being enumerated. Many of the upper streams of this river display the singular phenomenon which has been called "black waters." Under the shadow of the palm-trees their colour becomes of a deep black, but, in transparent vessels, it assumes a yellow hue. The absence of crocodiles and fish (which are very plentiful farther down), a greater degree of coolness, a smaller number of musquitoes, and a more salubrious atmosphere, distinguish the region of the black waters. Humboldt surmises that they derive their colour from a solution of carburet of hydrogen, resulting from the decomposition of the multitudes of plants that cover the soil through which they flow. With regard to the breadth, depth, and quantity of water discharged by the Orinoco, as well as the size of the delta which it has formed, our information is by no means precise. At six hundred miles from the ocean it is said to be from five to six hundred yards across, and at Angostura or St Thomas's, situated two hundred and forty miles from its mouth, to be nearly eight hundred yards across. Its depth appears to be very great; even when the waters are at the lowest, it is no less than sixty-five fathoms in some parts; and during the rainy season it inundates the immense plains through which it flows, extending during the highest floods from eighty to ninety miles on either side, and thus presenting to the eye the appearance of a vast inland sea, rather than a river. These facts, together with that of the vast extent to which the current of the river may be traced in the ocean, are sufficient to prove that the quantity of water brought down by the Orinoco is inferior to that of few rivers on the face of the globe. The annual swell of the Orinoco commences in April and ends in August. At the distance of thirteen hundred miles from the ocean the rise is about thirteen fathoms. In the beginning of October the water begins to fall, and, quitting the deluged plains, continues to diminish till March, when it is at the lowest ebb. This river abounds in fish of various descriptions. Amphibious animals are also found in great numbers on its shores; the cayman or alligator frequents its waters, and is very formidable. From one of the best maps of Colombia which have been published, it appears that its delta extends above one hundred and fifty miles in length at the base, and that from the middle of this line to the apex of the triangle it is above one hundred miles in depth. (R. R. R.)

Orion.

ORION, in fabulous history, was the son of Jupiter, Neptune, and Mercury. As these gods were visiting the earth, they entered the house of Hyrieus, a native of Tanagra, in Bœotia, under the character of benighted travellers, on account of his being famed for hospitality to strangers. Hyrieus treated them in the best manner possible; and even killed an ox, the only one he had, for their entertainment. With this the gods were so pleased, that they offered the old man whatever he should ask; and he having let them know that he desired nothing so much as a son, they, anxious to gratify his wish, caused the ox's hide to be brought before them, and having deposited in it their urine, bade him keep it under ground for nine months. He then dug for the skin, and found in it a beautiful child, whom he called *Urion.* The name was afterwards changed into Orion, by the corruption of one letter, as Ovid observes: *Perdidit antiquum littera prima sonum.* Orion soon became conspicuous, and Diana admitted him amongst her attendants, and even became deeply enamoured of him. His gigantic stature, however, displeased Oenopion king of Chios, whose daughter Hero or Merope he requested in marriage. The king, not willing to deny him openly, promised to make him his son-in-law as soon as he should have delivered that island from wild beasts. This task, which Oenopion supposed to be impracticable, was soon performed by Orion, who eagerly demanded his reward. Oenopion, on pretence of complying, made his illustrious guest drunk, and in this state put out his eyes on the sea-shore, where he had laid himself down to sleep, so that Orion, when he awoke from his debauch, found himself blind. Directed by the sound, he then went to a neighbouring forge, where he placed one of the workmen on his back, and by his directions proceeded to a place where the rising sun was seen with the greatest advantage. Here he turned his face towards the luminary; and, according to report, he immediately recovered his eye-sight, and hastened to punish the perfidious cruelty of Oenopion. Orion was believed to have been an excellent workman in iron, and to have fabricated a subterranean palace for Vulcan.

Some say that Orion was the son of Neptune and Euryale, and that he had received from his father the privilege and power of walking over the sea without wetting his feet; but others assert that he was a son of Terra, like the rest of the giants. He had married a nymph called Sida before his connection with the family of Oenopion; but Sida was the cause of her own death, by boasting herself fairer than Juno. Diodorus says that Orion was a celebrated hunter, superior to the rest of mankind by his strength and uncommon stature. He built the port of Zancle, and fortified the coast of Sicily against the frequent inundations of the sea, by heaping up a mound of earth called Pelorum, on which he built a temple to the gods of the sea. After his death Orion was placed in heaven, where one of the constellations still bears his name. The constellation of Orion was placed near the feet of the bull. It was composed of seventeen stars, in the form of a man holding a sword; for which reason the poets often speak of Orion's sword. As the constellation of Orion, which rises about the 9th day of March, and sets about the 21st of June, is generally supposed to be accompanied at its rising with great rains and storms, it has acquired the epithet of *aquosus*, which is applied to it by Virgil.

ORISSA, an extensive province of Hindustan, in the Deccan, between the sixteenth and twenty-third degrees of north latitude. It has Bengal for its boundary to the north, to the south the river Godavery, to the east the Bay of Bengal, and to the west the province of Gundwana. It may be estimated from north-east to south-west at 530 miles in length by ninety in average breadth. Orissa was formerly an independent Hindu kingdom. It was first conquered by the Afghans, and afterwards by the Moguls towards the end of the sixteenth century. It was in ancient times divided into five districts, namely, 1. Jellasir, comprising Midnapoor and the British possessions lying north and east of the river Subunreeka; 2. Buddruck (now Cuttack); 3. Cuttack; 4. Kulling or Cicacole; and, 5. Rajamundry. The principal modern subdivisions of this extensive province, independently of other petty states and large zemindaries, are, 1. Singhboom; 2. Kunjeur; 3. Mohurbunge; 4. Balasore; 5. Cuttack; 6. Khoordah.

This province, in the interior, is of a rude and barbarous aspect, consisting for the most part of rugged hills, uninhabited jungles, and deep water-courses. It is surrounded by pathless deserts, forests, or valleys; and the atmosphere is pestilential. There are only two passes in the great mountainous ridge that extends from the Godavery to the Mahanuddy; the one direct, from Chandah to Cicacole; the other oblique, from Choteesghur by the way of Kaluhindi, and both uniting at the pass of Saloor or Saureacca. But though Orissa is, generally speaking, a barren country, the south-eastern or maritime parts are equal in fertility to most parts of India.

At present the British rule over nearly one half of this extensive region, and the remaining part is possessed by tributary zemindars, called ghurjauts or hill-chiefs, who pay a fixed rent to the British, under whose jurisdiction they live. The woody and interior division of the country belongs to them; whilst the other division, belonging to the British, comprehends all the low lands extending along the coast, a tract generally plain and fertile, but not well cultivated or peopled. But the country occupied by the natives, though a barren tract of rock, forest, and jungle, and thinly inhabited, produces a surplus of grain beyond the consumption of its inhabitants. The British portion of the country produces, as its chief staples, rice and salt, the former of which is an article of export. Every sort of grain and vetch is cultivated, and the country is improving under its present administration; whilst the portion that is still under its native chiefs presents a scene of oppression and decay. The low lands along the Bay of Bengal abound with wild animals, such as hogs, deer, tigers, and jackalls; and the high lands are infested by such numbers of wild animals, that in many places they are regaining possession of the country from which they were driven by the progress of cultivation. Fish swarm in the rivers, which are also infested with reptiles and alligators; and in the plains and jungles are innumerable noxious insects. The chief rivers are the Godavery, Mahanuddy, Byturnee, and Subunreeka, besides innumerable mountain streams of a short course.

The country between the rivers Gaintee and Bamoni is peculiarly fertile, and is inhabited by an industrious class of persons, weavers, chiefly of coarse muslins for turbans, and sanaes, which are a staple manufacture. The districts to the west of Bengal are mountainous, and inhabited by a savage race of Hindus, who are still called Oureas. They go nearly naked, and are armed with bows and arrows, and are nominally subject to the Mahrattas, though they pay but little revenue. They are naturally a fierce people, possessing personal courage in a great degree. They are great enemies of the Mahrattas, who plunder and oppress them; but those under the British dominion are a mild and tractable people, and the palanquin-bearers in Calcutta are mostly from that country. These bearers have high and proud notions: they pretend to be of a higher caste than the bearers from Bahar, and are very fastidious about performing their duties.

In the ancient history of the Hindus, Utcala or Odradesa, implying the great or famous country of Cala, was nearly co-extensive with the modern Orissa; but the martial race by whom it was inhabited were at last extirpated by the karnas or kings of Magadha. A race of Hindu princes governed the country in 1592, and were conquered by the viceroy of Akbar, to whose dominion the country was annexed as a dependent government. It then measured 600 miles along the sea coast by forty in medium breadth, extending from Tumlook on the banks of the Great Ganges, to Rajamundry on the Lesser Ganges; and was inhabited by the Oureas, a race of Hindus, of peculiar and distinct language, manners, and religion. From disjointed fragments of its history, and from existing relics, it appears to have been a flourishing empire, even before the Mahommedan invasion; but it soon afterwards fell into decay. When the Afghans were expelled from Bengal by the Moguls in the sixteenth century, they took refuge in Orissa, and retained possession of part of it, including the celebrated temple of Juggernaut, till near the year 1615. (F.)

ORISTANO, a city of the island of Sardinia, situated on the western side of the gulf or bay of that name. It is the seat of an archbishop, and has a cathedral, a nunnery, several monasteries, and a harbour about a mile from it, into which the river Oristano enters. The air is very impure. Oristano contains 4990 inhabitants.

ORIZAVA, a town of Mexico, in the state of Vera Cruz. See the article MEXICO.

ORKNEY ISLANDS, or ORCADES, a group of islands in the North Sea, belonging to and forming with the Zetland Islands one of the counties of Scotland. They are separated from Caithness by the Pentland Firth, a strait of about twelve miles in breadth, and are situated between the parallels 58. 44. and 59. 24. north latitude, and between 2. 24. and 3. 20. west longitude from the meridian of Greenwich. In number they amount to sixty-seven, of which twenty-seven are inhabited; and the others, known by the name of *holms*, are employed as grazing grounds for sheep and cattle, and for the manufacture of kelp. The islands are divided into two groups, called, in reference to Pomona, the principal island, the North and South Isles. The following are the names of the inhabited islands in the southern division, with their population according to the census taken in 1831:

South Ronaldshay	2265
Walls and Hoy	1388
Flotay and Faray	369
Burray	357
Græmsay	225
Swanay and the Skerries	89
Copinshay	7
	4700

The following are the names and population of the North Isles:

Sanday	1839
Westray	1702
Stronsay, Papa Stronsay, and Lingholm	1071
Rousay	921
Shapinshay	809
Eday and Pharay	756
North Ronaldshay	522
Papa Westray	330
Egilshay	228
Weir	93
Gairsay	69
Enhallow	20
	8360

Pomona, or the Mainland, has a population of 15,787, and thus the whole number of inhabitants amounts to 28,847.

Orkney has been computed to contain 150,000 square acres, and, of these, 100,000 are said to be waste, or covered by water. But the very irregular form of the islands, penetrated by arms of the sea in all directions, renders these estimates, in absence of any accurate survey, nothing more than approximations. The general appearance of the islands is bleak, and upon the whole uninteresting. The total want of wood, and the immense tracts of waste, uncultivated land, present a very forbidding aspect.

The climate is exceedingly moist, and, though the cold is not very intense, the variable weather renders the winter disagreeable in the extreme. For several months there is a succession of rain, sleet, and storms. Spring is late, damp, and cold; but an Orkney summer, though short, has many and peculiar charms. The length of the day, the duration of twilight, the rapid vegetation, and, above all, the stillness of the sleeping ocean on a calm evening, compensate in no small degree for the dreariness of the other seasons.

Orkney is divided into twenty parishes, composing three presbyteries and one synod. Together with Zetland, these islands constitute one sheriffdom or stewartry, under the jurisdiction of a sheriff-depute and two substitutes, whose courts are held at Kirkwall in Orkney, and Lerwick in Zetland. Till the passing of the reform bill, Orkney alone had the privilege of sending a member to parliament; the landholders of Zetland, owing to the want of a separate valuation of their estates, having no vote in the election. Of the land-tax payable for the county, two thirds are levied from Orkney, and one third from the other division of the stewartry.

We shall now proceed to notice the principal islands, pointing out the most remarkable objects in them. The most southerly is South Ronaldshay, containing twenty-four square miles, and a population of 2265 persons, chiefly employed in agriculture, and the lobster, cod, and herring fisheries. There are two commodious and secure harbours in this island, Widewall Bay on the west, and St Margaret's Hope on the north. The antiquities of the island are several Picts' houses, three or four monumental stones of large size, and the How of Hoxa, an ancient stronghold. To the north-west of South Ronaldshay lies Hoy, an island of twice the extent, but containing only 1388 inhabitants, the greater part of it being high land covered with heath. This is in many respects the most interesting of all the islands. The Wart Hill, the highest mountain in Orkney, its towering precipices washed by the fury of the Western Ocean, the huge isolated rock called "the Old Man of Hoy," the meadows of the Kaim, the beautiful vale o. Berrydale, through which flows a stream whose banks are fringed with birches, creeping juniper, and willows, and the dwarfie stone, present to the spectator objects which will amply repay a lengthened visit. Forming part of the island of Hoy, but constituting a different parish, is Waas, or Walls, distinguished chiefly for its excellent harbour, Long Hope, which is now protected by a small battery and a couple of martello towers. Burray, situated to the north of South Ronaldshay, and separated from it by a channel of a mile in breadth, has an area of only three square miles, but produces grain, green crops, and good pasture, and has, moreover, a valuable rabbit warren. Farther north is the largest island of the group, Pomona, or Mainland, extending to thirty miles in length, and containing upwards of two hundred square miles. The towns of Kirkwall and Stromness are in this island (see articles KIRKWALL and STROMNESS). Pomona is divided into thirteen parishes, which are supplied by eleven clergymen. Of these divisions, if we except St Ola, or Kirkwall, Stennis has the greatest claims on the attention of the traveller or the antiquary. Here are the Stones of Stennis, two collections of what at one time must have been upright pillars, forming a circle and a semicircle. Many of these stones are now overthrown; but the circle, when complete, seems to have been formed of thirty-five blocks; its diameter is three hundred feet, and the stones of which it is composed vary from ten to sixteen feet in height, and from two and a half to five feet in breadth. There have been many conjectures as to the purpose of these erections, and it is by no means certain even by whom they were raised. One opinion is that they are of Druidical, and another that they are of Scandinavian origin. A very probable conjecture is, that the circle was dedicated to the sun, and the semicircle to the moon, the frequent objects of Scandinavian worship. Of these stones the most interesting was one which stood near to, but did not form part of, the circle; it was perforated by a small hole, through which the heads of children were passed in order to secure them against palsy in after-life, and through which also lovers' hands were joined, in token that the vows then made should be faithfully kept. The contracts or agreements here made were peculiarly binding, and the promise of Odin was regarded by an Orkneyman as of too solemn a nature to be trifled with. The malice or stupidity of a stranger, who rented a neighbouring farm, induced him, in 1814, to overthrow and break to pieces this curious relic of ancient times. In front of the circle there is a large horizontal stone, conjectured to have been used for sacrificial purposes; and it has been thought that it was on this altar that Einar, jarl of Orkney, son of Ronald, about the year 893, or, according to other accounts, 930, stretched Halfdan, the son of Harold the fair-haired, king of Norway, and, tearing out his lungs, presented the reeking gift to his god. In the adjoining parish of Sandwick, the gran-

Orkney. deur of the rocks must attract the attention of the visitor; and one huge archway, formed by the restless fury of the waves, called the Hollow Row, or the Hole of Row, is particularly deserving of attention. Robert Steuart, earl of Orkney, had a palace in Birsay, the next parish on the north-west, the ruins of which still remain. Brand, who visited the county in 1700, says, "the palace is two stories high, the upper hath been prettily decored, the ceiling being all painted, and that for the most part with schems holding forth Scripture histories, as Noah's flood, Christ's riding to Jerusalem, &c. and the Scripture is set down beside the figure. It was inhabited within these twenty years, but is now fast decaying." The writer of this article saw it in 1820. All the decorations, the roof, and a great part of the walls, were then gone; and the clergyman of the parish informed him that the palace was regarded as a common quarry, whence every intending builder drew materials for the erection of his house. It was over the gateway of this building that the inscription was placed which is said to have been adduced as evidence of the treasonable designs of the family on the trial of Patrick, Earl Robert's son: "Dominus Robertus Stuartus, filius Jacobi quinti, *rex* Scotorum, hoc opus instruxi." The two islands of Shapinshay and Rousay, each containing from ten to twelve square miles, lie to the north of the Mainland. In the former lead ore has been found, but not in quantities sufficient to remunerate the miner; and the latter presents to the antiquary for his investigation, tumuli, Picts' houses, standing stones, and a number of ancient graves. To the east of Rousay is the beautiful island of Egilshay, the favourite summer residence of the ancient jarls, and, at a later period, of the bishops of Orkney. It was here that St Magnus, the tutelar saint of the islands, was basely murdered by his cousin Hacon, in 1110. Beyond these, to the north-east, lie Stronsay, where there is an extensive fishing station; and Eday, an island that can boast of a burgh of barony. Still farther north lie Sanday on the east, and Westray on the west. The former, because of its superior productiveness, has been called the granary of Orkney; and it produces, or rather did produce, fully one fifth of the kelp manufactured in all the islands. It is a flat, low-lying island; and, till the erection of a lighthouse in the year 1806, proved fatal to many a vessel. Westray is, with the exception of Sanday, the largest of the north isles. In it are the remains of a strong castle, of which Ben, who wrote in 1529, thus speaks: "Est excellentissima arx sive castellum, sed nondum tamen adhuc completa." A great many graves, generally formed of five flat stones, four standing on their edges, and resting on the fifth, have been lately uncovered, in consequence of sand blowing. In them have been found the remains of human bones, and of various weapons, offensive and defensive. In all probability they are the graves of natives and strangers, who had fallen in some of the many battles of which tradition preserves the remembrance. Separated from Westray by a frith of a mile in breadth, is the small island of Papa Westray, with its beautiful fresh-water loch, in the middle of which is a small island, whereon stood the chapel of St Tredwall. The most northerly of the islands is North Ronaldshay, containing an area of from four to six square miles, with a population of 522. It was on a reef near this island that the Suetia of Gottenburg, an Indiaman, valued at half a million sterling, was wrecked in 1740; and here, too, four years afterwards, another Indiaman, the Crown Prince of Denmark, with thirty chests of treasure on board, was cast away. About the year 1790, a lighthouse, seventy feet in height, was erected on the north-east point of the island; but this light being often mistaken for that in Sanday, misled mariners, and it is now discontinued, the latter being regarded as sufficient.

The geology of these islands offers little to attract our attention. The Orkneys are said to consist of an assemblage of secondary strata, disposed round a high central nucleus of primitive rocks; but Professor Traill remarks, that "the mineral history of Orkney is singularly monotonous and uninteresting; the whole islands, with slight exception, consisting of horizontal or slightly inclined strata of sandstone, flag, and a species of slaty clay, occasionally intermixed with thick beds of red and gray sandstone, and, in a few places, containing beds of limestone, with some traces of marine remains."

The Orkney Flora is known to consist of 545 species, to which it is probable that a careful examination will make some additions. The *chara aspera*, discovered by the Rev. Charles Clouston, minister of Sandwick, is the only Orkney plant new to the British Flora.

The zoology of Orkney, according to the *Fauna Orcadensis* of Low, is as follows: Quadrupeds, eleven genera; birds, thirty-four genera; reptiles, two genera; and fishes, twenty-three genera. To these a few additions, we believe, have been made.

The history of the islands will not detain us long. They seem to have been originally peopled by a Scandinavian tribe; but little certain is known till the year 870, when the Norwegian chiefs, who had fled from home because of the victories of Harold the Fair-haired, arrived there. Harold pursued them six years afterwards, defeated them, and appointed Ronald count of Moere jarl or earl of Orkney. He was succeeded, after an interval and some changes, by his son Einar; whilst another son of his, Rollo, wrested Normandy from Charles the Simple, king of France, and, becoming duke of that province, was the great-great-great-grandfather of William the Conqueror. The descendants of Ronald ruled as jarls for upwards of four hundred years, when the male line terminated in the person of Magnus, the fifth earl of that name. He died about 1320 or 1330, leaving one daughter, Matilda, who became the wife of Malise, earl of Stratherne, and had issue Isabell, who married Sir William St Clair, baron of Rosslyn; and the son of this marriage, Sir Henry, was the first of the *Scottish* Earls of Orkney. His title was admitted by Hacon VI., king of Norway, in 1379. By a treaty entered into before this period, between the courts of Scotland and Norway, the latter ceded to the former Man and the Western Islands, for the payment of a certain yearly sum called the "Annual of Norway." This tribute, not having been regularly rendered, soon amounted to a large sum; but, after much negotiation on the subject, it was arranged that the arrears of the *annual* should be held as discharged, that James III. should marry Margaret of Norway, that her dowry should be 60,000 florins, and that Orkney should be impignorated to Scotland for five sixths of that sum, the islands to be redeemed on the payment of the money. This treaty was entered into in 1468. The marriage-portion was never paid, and it has given rise to much controversy, whether the claim of Norway to these islands has been ever formally relinquished; a question into which we shall not enter, as it has been for centuries practically resolved. The earldom remained in the family of St Clair till 1471, when it and the title merged in, or rather was united to, the crown of Scotland, never again to be alienated, except in favour of a lawful son of the king. For almost a century the crown-lands were leased to various tenants, till at length, in May 1564, Queen Mary granted a charter to Lord Robert Stuart, her father's son by Dame Euphemia Elphinstone, constituting him Earl of Orkney. Afterwards, by her marriage-contract with Bothwell, dated May 1567, Mary bound herself to create him Duke of Orkney, and to put him in possession of the islands. He appears never to have been infeft, or, at all events, a month after the marriage, he fled, and the dukedom was at an end. Earl Robert had no concern with Orkney from 1567 to 1581, but in the latter year he had another grant of the earldom made to him. This was revoked by King James upon his attaining his majority in 1587. Again, a farther grant was executed in favour of him and his heirs in 1591, which in 1592 was confirmed by parliament. Earl Robert died in that year, and the earldom was once more resumed by the crown; and once more, in March 1600, Patrick, the son of Robert by the Lady Jean Kennedy, got a grant of it in his favour; and in May of the same year he got a grant of the bishopric. Earl Patrick's crimes brought him to the scaffold in 1615; and after his death the Orkneys were again unalienably annexed to the crown, and again they were alienated in 1643. This deed was declared null and void in 1669; and once more, in 1707, they were mortgaged to the Morton family, burdened with an annual payment of L.500 to the crown. In 1742, this mortgage was declared irredeemable, and Lord Morton in 1766 sold his rights for L.60,000, to Sir Laurence Dundas, in whose family they still remain. From a calculation made by Sheriff in his agricultural survey, printed in 1814, it would appear that Lord Dundas draws annually from his vassals in the earldom L.2187. 11s. $9\frac{2}{3}\frac{2}{4}$d., payable partly in money and partly in produce. In addition to this he has a large private property in the county.

Of the trade and manufactures of Orkney, it is not easy to give any thing like an accurate estimate; but the following may be looked upon as generally correct.

Years.	Exports.	Shipping.	Ships.	Sailors.
	L.	Tons.		
1770	12,018	825	17	76
1780	23,257	940	20	90
1790	26,598	2000	23	170
1800	39,677	1375	21	119
1820	...	2841	46	300
1833	...	4049	78	319

The exports consist chiefly of grain, fish, cattle and sheep, butter, hides, rabbit-skins, and eggs. In 1833, it is said, 100,000 dozens of eggs were exported, which, at 6d. a dozen, brought L.2500. The imports are of a most miscellaneous description, and we have seen no probable estimate of their value.

Till lately, the principal manufacture in the islands was that of kelp, which at one time brought L.12, L.16, and even L.20 a ton; but now the prices obtained barely suffice to cover the expenses of making and carrying it to market. The greatest quantity ever made in one year was in 1826, when 3500 tons were manufactured, which, on an average, sold at L.7 a ton. The expense of cutting, drying, and burning the sea-weed, amounts to about L.3 or L.3. 3s. a ton of kelp, and it costs about L.1 more to bring it to market; and, for some years, the price has scarcely exceeded L.4. 10s. or L.5.

In 1833 there were forty vessels of about thirty tons each engaged in the cod-fishery, and they caught and cured 560 tons of fish, valued at L.13 per ton. During the same year, the produce of the lobster-fishery, in which there were engaged 216 boats and 432 men, amounted to L.1800. The principal fishery, however, is the herring-fishery. In 1820 there were exported from Orkney 17,989 barrels of herrings, which, at 10s. a barrel, would amount to about L.8000; and in 1833 the number had amounted to 34,000 barrels, valued at L.17,000. The principal stations for this fishery are Huip in Stronsay, and St Margaret's Hope in South Ronaldshay.

The chief manufacture in Orkney at present is that of straw-plaiting. Twenty years ago, from six to seven thousand females were employed in this branch of trade; and they are calculated to have drawn in wages L.20,000 annually. Since that time the plaiting of common straw has been almost entirely discontinued, and that of the unsplit straw of rye or wheat has been introduced. In 1833 there were plaited 489,560 yards of Orkney straw, and 240,900 yards of foreign straw. The former is thought tougher than the latter, but the colour is not so pleasing. A bonnet that will cost L.4 contains about 140 yards of the finest plait.

In Kirkwall there are two licensed distilleries, and there is one in Stromness. In 1833 there were distilled 13,947 gallons of whisky, yielding to the revenue L.2324. 10s. of duty. It has been calculated, that during the year to which these estimates chiefly refer (viz. 1833), upwards of L.60,000 was received in Orkney, principally from fisheries, farm produce, and manufactures.

When Dr Barry wrote his history of Orkney, more than thirty years ago, he pointed out many defects in the system of Orkney farming. Some of these still remain, but many of them have disappeared; and, as old prejudices wear away, and landlords see that it is for their own no less than for their tenants' advantage to grant leases of some duration, and when both parties are convinced that a proper rotation of crops should be insisted on, and when fencing and draining have been carried to a greater extent than has yet been done, we may hope to witness a still more marked improvement. The grain almost exclusively raised in Orkney is barley, or rather bear or big (*hordeum tetrastechon*), and gray oats (*avena strigosa*). We have seen wheat tried, but the result of the experiment was not encouraging.

In conclusion, we would remark, that the inhabitants of these islands are in general not overmuch inclined to labour when at home, but that when abroad they can be made to exert themselves. They are somewhat superstitious, but are nevertheless well informed on many subjects; whilst the upper classes, as a body, are not inferior to their equals in station in any part of Scotland. All classes are universally acknowledged to be kind, courteous, and most attentive to strangers.

(*Orkneyinga Saga*; Torfæi *Rerum Orcadensium Historia*; Brand's *Brief Description of Orkney, &c.*; Wallace's *Description of Orkney*; M'Kenzie's *Greevances of Orkney*; Fea *On the Fisheries of Orkney*; Low's *Fauna Orcadensis*; Barry's *History*; Sheriff's *Agricultural Scenery*; Neill's *Tour*; Peterkin's *Rentals and Notes*; Groat's *Thoughts on Orkney*.)

ORLE, ORLET, or *Orlo*, in *Architecture*, a fillet under the ovolo, or quarter round, of a capital. When it is at the top or bottom of a shaft, it is called *cincture*.

ORLEANS, an arrondissement of the department of the Loiret, in France, extending over 1012 square miles. It comprises fourteen cantons, divided into 111 communes, and in 1836 contained 141,637 inhabitants. The capital is the city of the same name, being the seat of a bishop, and of the departmental boards of the government and courts of law. It stands on the right bank of the Loire, over which there is a fine bridge of sixteen arches. It is surrounded with walls, which, being planted with trees, form pleasing promenades. In general, it contains anciently built houses, and narrow streets, though there is one exception in the suburbs. The cathedral is a fine old building, as well as the town-house, and the châtelet, formerly the residence of the Duke of Orleans. There are five hospitals, an exchange, an academy, a lyceum with a library of 36,000 volumes, and a theatre. The city contains 4600 houses, with 40,272 inhabitants. It is a place of extensive trade, having manufactories of serges and other woollens, several sugar-refineries, distilleries, breweries, and china-works. It is also a dépôt for the wines of Languedoc and Guienne, and for brandies of its own preparation, as well as for those of Cognac, Chinan, Samur, and Blois. It has long given a title to a branch of the Bourbon family, and has been much celebrated for its defence under the famous Maid of Orleans. Long. 1. 49. 23. E. Lat. 47. 54. 10. N.

Orleans, New, a city of Louisiana, one of the United States of North America. See Louisiana.

Orleans, *Peter Joseph*, a French Jesuit, was born at Bourges in 1641. He taught belles-lettres for some time in his society, but afterwards devoted himself to the writing of history; and this pursuit he continued till his death, which happened in the year 1698. He wrote a History of the Revolutions of England; a History of the Revolutions of Spain; a History of two conquering Tartars, Chunchi and Camhi; the Life of Father Coton; and some other pieces. His History of the Revolutions in England, under the family of the Stuarts, from the year 1603 to 1690, was translated in English, and published at London in 1711, one vol. 8vo; to which is prefixed an Introduction, by Mr Laurence Echard, who says, that "the great varieties and wonderful changes in these reigns are here judiciously comprised in a moderate volume, with no less perspicuity than strictness, and with a beautiful mixture of short characters, nice reflections, and noble sentences, which render the whole agreeable and instructive."

ORLOP, in nautical language, the uppermost space or deck in a great ship, reaching from the main to the mizenmast. In three-deck ships, the second and lowest decks are sometimes called *orlops*.

ORME, Robert, the historian of British India, born at Anjengo, in Travancore, was the son of Dr Alexander Orme; and his mother was a Miss Hill, a sister of Mrs Robert Adams.

He was sent to England at the age of two years, and placed under the care of Mrs Adams, who lived in Cavendish Square. His literary education commenced very early, for he went to Harrow at six, having been previously, for a twelvemonth, under the private tuition of a clergyman in the neighbourhood. For seven or eight years he applied to his classical studies as a school-boy with great diligence; and when he was thirteen, he was placed in the office of the accountant of the African Company, in order to gain some practical knowledge of the principles of commerce.

In 1742 he went out to Calcutta, and was there engaged in a mercantile house of respectability; he made a voyage to Surat in their concerns, and on his return, in 1743, he received from England the appointment of a writer. Five years afterwards he was promoted to the rank of factor in the company's service. In 1752, having been desired to give his opinion on the regulation of the police of Calcutta, he drew up a memorial on the subject, which did great credit to the accuracy and profoundness of his views of the manners, the habits, and the interests of the country.

He returned to England in 1753, upon a visit to his aunt, and he was much consulted, during his stay in London, by Lord Holderness, then secretary of state, with regard to the policy to be observed towards the French government respecting the affairs of India. He went out again in 1754, and took his seat as a member of the council at Fort St George. He had here an opportunity of effectually serving the company by the vigour of his political conduct, and of greatly contributing to the establishment of the decided preponderance of the English interest in India. After the well-known affair of the Black Hole of Calcutta, he was particularly active in promoting the appointment of Colonel Clive to the command of the expedition destined to punish the cruelty of the tyrant who was the author of that outrage; although his friendship with Colonel Clive did not continue uninterrupted through life. Mr Orme's exertions on this and other occasions were so highly appreciated by the directors, that he was nominated as eventual successor to the government of Madras; but he did not stay long enough to profit by the appointment. In the capacity of accountant-general, he became intimate with Mr Alexander, afterwards Lord Caledon, who was his deputy, and with Mr Dalrymple the hydrographer, to whom he showed many civilities, from a conviction of his merits. Mr Benjamin Robins, the historiographer of Anson's Voyage, had also been one of his early friends, that is, during his first residence in India; for this singularly active person died in 1751.

Mr Orme's situation in India was extremely favourable for the acquisition of historical information, which it was the delight of his life to collect; but his health requiring a change of climate, he sailed for Europe on board of the Grantham in 1758. The ship, however, was captured in January 1759, off the Cape of Good Hope, and carried to the Mauritius; but after having been detained there for some time, Mr Orme was allowed to proceed to the Cape, and thence to France. Having landed at Nantes in the spring of 1760, he paid a visit to Paris, where he amused himself for some months with the literature and the theatres of the day; and his biographer has preserved some interesting remarks that they suggested to him. In October he arrived in London, and engaged a house which had been lately built in Harley Street.

He employed himself for the two succeeding years upon his Military History, sparing no pains nor expense to complete the collection of materials, which he had begun to form in India, and to prepare the work, with all possible care, for the press. The first volume appeared in 1763, and was received with great approbation. The company not only granted him free access to their records, but gave him also the appointment of their historiographer, with a salary of L.400 a year. After this time, he resumed some of his classical studies, which he had discontinued so long as to have forgotten almost all that he had learned; but he soon recovered his knowledge of the ancient languages, and added to them afterwards such of the modern ones as he found likely to be subservient to his pursuits. His hours of leisure were chiefly passed in the enjoyment of literary society; he became a fellow of the Society of Antiquaries in March 1770; and about the same time he became intimate with Lord Sandys, and with Sir James Harris. Sir William Jones, Dr Robertson the historian, Dr Pemberton, Dr Wilson, Athenian Stuart, and Nourse the bookseller, were also among his particular friends; as well as Mr Rouse Boughton, afterwards Sir Charles Rouse Boughton, to whose urbanity and thorough acquaintance with the Persian language he was indebted for several of his historical documents. He obtained additional information for the completion of his History from the French general De Bussy, who had been much concerned in some of the transactions narrated in his first volume, and who was so much satisfied with his candour and impartiality that he invited him to his house in the country, and entertained him there, in 1773, with great kindness and hospitality.

After the publication of the second volume of his History, he had ample leisure to amuse himself with literary pursuits of a more general nature; but in 1784 he suffered a severe affliction from the loss of his nephew, Mr Hosea, who was shipwrecked, with his wife and family, upon their return from India, on board of the Grosvenor. In 1792 he retired to Ealing, where he continued to reside till the time of his death, which happened on the 13th of January 1801.

Good sense and sound judgment were the principal features of his character. His works are more distinguished by simplicity, clearness, and precision, than by any very powerful eloquence, or a very nice discrimination of character. He was not, however, deficient either in command of language or in poetical feeling. Sir William Jones and Dr Robertson paid him some very high compliments, in their private correspondence, for the elegance and purity of his style; and the former of these writers has also characterized him, in his third Discourse, as possessing an "exquisite taste for every fine art." We find also, amongst a few miscellaneous poems collected by his biographer, a remarkable little Address to the Moon, written at Madras in 1757, which is manifestly the original of a well-known Greek epigram and a Latin ode of Sir William Jones; and certainly the compliment of having been "set to music, and much admired," must be considered as far inferior to that of having been repeatedly imitated and translated by a poet of a judgment so correct, and a taste so refined, and having been called the production of "a man of great talents, and a particular friend of the translator."

1. Of his works, the earliest in its origin was his General Idea of the Government and People of Indostan. It was principally written in 1752, and finished during his return to England in the next year. A part of it was prefixed to his Military History, and it is printed in its entire state among his posthumous works.

2. History of the Military Transactions of the British Nation in Indostan, from the year 1745. A Dissertation on the Mahommedan Conquests and Establishments in Indostan is prefixed to the first volume. "No historian," says the author of the Annual Register for 1764, "seems to have been more perfectly informed of the subject on which he has undertaken to write; and very few have possessed more fully the talent of impressing it, in the clearest and most vivid manner, on the imagination and understanding of his reader." The first volume, published in 1763, extends to 1756; and the second, published in 1778, carries the history down to the peace of 1763.

3. Historical Fragments of the Mogul Empire, from the year 1659, 8vo, London, 1782; first published anonymously, but acknowledged and reprinted in 4to in 1805; together with the Origin of the English Establishment at Broach and Surat, the General Idea of the Government and People of Indostan, and a Life of the Author. The Historical Fragments is a work of considerable research, making a sort of episode to the Military History, to which it affords some additions and corrections. It relates principally to the sanguinary Aurungzebe and his immediate successors, and to his contemporary, Sevagi the "Morattoe," the professed descendant of Porus. The Essay on the Trade of Surat is a fragment which was left unfinished by the author.

4. Several hundred volumes of Mr Orme's manuscript collections, together with some scarce printed tracts relating to oriental history, are carefully preserved in the library of the East India Company.

ORMEA, a city of the province of Mondovi, in the continental part of the kingdom of Sardinia, and situated on the river Tanaro. It is surrounded with old walls, and has a citadel, a collegiate church, and 800 ill-built houses, with 5460 inhabitants, who carry on an extensive trade in linens.

ORMOND, the northern division of the county of Tipperary, in the province of Munster, in Ireland. For a long time it gave the title of earl, and afterwards of marquis and duke, to the noble family of Butler, descended from a sister of St Thomas a Becket, archbishop of Canterbury; till, at the accession of George I. the last duke was attainted of high treason, and died abroad. In that part of the country the family had great prerogatives and privileges, which were granted by Edward III.

ORMSKIRK, a market-town of the hundred of West Derby, in the county of Lancaster, twelve miles from Liverpool, and 210 from London. The parish is very extensive, comprehending six townships and one chapelry. The town is well built, consisting of four streets crossing each other at right angles. Its church is a handsome Gothic structure, and is remarkable for having the tower and the steeple detached from each other, so as to appear like two churches. There is a good market on Thursday, and considerable trade at all times, arising from the navigable canals, to which there is easy access. The population of Ormskirk township amounted in 1801 to 2554, in 1811 to 3064, in 1821 to 3838, and in 1831 to 4251.

Ormuz.

ORMUZ, a barren island in the Persian Gulf, on which was formerly built a city, forming a vast emporium of Indian trade, and celebrated for its wealth and its extended commerce all over Asia. This island is about twelve miles in circumference, and resembles, when viewed from the sea, a mass of rocks and shells thrown up by some violent convulsion from the bottom of the ocean. Not more than 500 inhabitants are contained within the walls of the fort and a wretched suburb. A range of hills intersects the island from east to west, from the suburb to these heights is about a mile and a half, and the ground continues level about two miles along the northern shore. This whole space is one mass of ruins; and it is only where the reservoirs of water have been made that the buildings are in any thing like a perfect state. According to the account of Kinneir, these appear to have been made in the shape of a hollow cylinder, covered by an arch of solid masonry; and it is probable, he adds, that every house of consequence had one of these reservoirs, as there is only a record of one well of fresh water ever having been on the island, and that is now dry. The rocks of Ormuz consist almost entirely of fine crystal salt; and, from various specimens which are found on the surface, there can be little doubt of its abounding with sulphur and a variety of metals, especially iron and copper. It is mentioned that the southern part of the island is one entire heap of cliffs and rocks. These sink abruptly, towards its northern extremity, into a plain, comprising an extent of six or eight square miles of comparatively level country, terminating in a sandy spit that divides the harbour of Ormuz into two parts, and on which stands the old Portuguese fort. The harbour is tolerably good, being surrounded on all sides by the land, though the bottom affords good anchorage. The fort, which is still in a good state of repair, is built on a narrow neck of land jutting into the sea, by which the walls are washed on the northern and western sides, and was never of great extent or regular figure. The walls have been most carefully and substantially built of the rock afforded by the island. Strong bastions command each face, and the height from the water to the ramparts may be about eighty feet. The walls are in good repair, but the interior is in ruins. Two large reservoirs for supplying them with water still subsist, and both are covered in. The roof of one rests on two rows of massy pillars, and its diameter is about 100 feet. The fort was formerly separated from the mainland by a canal cut through the neck of land, and this was crossed by a drawbridge; but it is now chiefly filled up, the eastern part serving as a dock for repairing boats. A rotten plank is the only passage to the gateway, which is strongly defended by guns from the neck of the opposite bastion. Several iron and two brass guns are mounted on the walls, bearing the Portuguese arms. The carriages of the guns are so bad that they would not bear a single discharge. A mud wall, just beyond the old ditch, encloses between itself and the fort the few miserable huts that are occasionally tenanted on the island. "Beyond this," says Frazer, in his Narrative of a Journey through Khorassan (p. 47), "upon the plain extending to the feet of the mountains, lie scattered the ruins of the ancient Arabian and Portuguese city, with its villas and seats, which are constructed of such perishable materials that scarcely

Ormuz. any relics of importance are to be seen." The only remarkable object is a tower near the wall, which Frazer conjectures to have been a minaret built by Shah Abbas after he had captured the place. Along the shore both of the eastern and western bays, not far from the water's edge, may be still seen a row of ruined houses, arcaded into apartments of various sizes and dimensions, which, in the opinion of Frazer, have been sirdabs or underground apartments for retiring to in warm weather, or cellars for receiving merchandise. The whole was of the same solid architecture as the first. The ground beyond, for a considerable space towards the mountains, was thickly strewed with broken tiles, pottery, glass, and the other usual destructible relics of an eastern city thrown into heaps of rubbish. Ormuz thus was possessed of no natural advantages, either from soil or climate; the heats during the summer being scarcely supportable by the human frame. It produces no articles of provision, not even a drop of water; so that it required a great exertion to render it habitable. The greater portion of the island consists of volcanic rocks, and the remainder of uneven stony places, strongly impregnated with salt; so that the means of improving the country do not exist. Not a tree nor a shrub can be raised; for the first necessary, water, is entirely wanting, and all vegetable supplies come from Kishmee or the mainland. Considering the barrenness of the island, Frazer doubts where the blooming and aromatic shrubs, that in former times were said to have decorated the streets, could have been found. The surface of the plain, though level when contrasted with the mountains beyond it, is still found extremely rugged on a nearer approach, and broken into ravines. The rocks are strongly impregnated with iron; they rise in rugged amorphous masses, strewing the ground with ruins, from which the mountains rise abruptly in bare desolate crags, and sharp, lofty peaks, of every variety of form and hue. "In many parts," says Frazer, "these, as well as the plains below, have a volcanic appearance, and a looseness of texture that alarms the traveller lest the surface should give way under his foot, and swallow him up in yet smoking ashes." The only products of Ormuz are iron in various shapes, sulphur; salt, which is produced from several salt springs, and is the only source of revenue in the island. The export in the company's ships is prohibited, lest it should interfere with the monopoly of salt in India. But the export to other places is considerable. The garrison of Ormuz consists of eighty soldiers belonging to the imaum of Muscat, who live immured in this desolate spot in great wretchedness. The broadsword and the target are their chief arms. These swords are sharp and thin, and previous to an attack they make them quiver and ring in the hand, with a jerk, whilst held in an upright position, and then charge with loud shouts. Ormuz was entirely indebted for its pre-eminent splendour to commerce, and it was long the great dépôt both of Indian and European produce. When the Portuguese fleet had found their way to India round the Cape of Good Hope, they soon cast a covetous eye on the wealth of Ormuz. They made several attempts to gain possession of it, but without effect, till in 1514 it surrendered to Albuquerque, who approached with an overwhelming force. It continued to be one of the chief seats of the Portuguese power till the reign of Shah Abbas, who conceived the plan of its conquest, and of attaching it as an appendage to the Persian empire. His attempt would have been vain had he not been aided by an English squadron which happened to be cruizing in these seas; and the commanders of which, being hostile to the Portuguese, readily fell in with the schemes of the Persian monarch. Their combined forces having landed, obliged the Portuguese to evacuate the town and to retire to the castle, which was at last reduced, chiefly by famine. Under the Persian regime the town decayed; the trade was ordered by the Shah to be transferred to Gombroon, on the opposite coast; and all the inhabitants at last followed, leaving only a Persian garrison. About the end of the last century Ormuz was taken possession of by the imaum of Muscat, and the inhabitants were then reduced to forty families. But the fort has since been repaired, and now contains 500 families. Long. 56. 40. E. Lat. 27. 8. N.

Orne. ORNE, a department of France, formed out of the southern part of the ancient province of Normandy and a portion of the division of Perche. It lies between north latitude 48. 12. and 48. 58., and in longitude between 1. 1. and 0. 50. west. It is bounded on the north by the departments of Calvados and Eure, on the east by Eure and Loire, on the south by Sarthe and Mayenne, and on the west by La Manche and the sea. It is 2524 square miles in extent, or, according to the Almanac Royale, 645,254 hectares, of which 318,750 are under the plough, 63,750 are meadows and pasture, 61,500 are woods, and the remainder is uncultivated, or the sites of towns, and the courses of rivers, or roads. It is divided into four arrondissements, thirty-five cantons, and 627 communes, and contains a population of 443,688 persons, who almost all adhere to the Roman Catholic church. The face of the country is hilly, though few of the elevations exceed 600 feet. The valleys between these hills are most abundantly supplied with streams of water, and it is said that no less than 300 rivers, great and small, have their sources within the department. As a whole, it thus appears to be a lofty region. The Orne, the Mayenne, and the Sarthe, are the great rivers by which the water of the smaller streams runs to the ocean. There are many morasses, ponds, and small lakes between the hills, but no canals. On the hills the soil is of a very sterile character, yielding only some scanty pasturage for cattle. In the valleys it is better, but much of it is either sandy or very stony. The climate is cold, but dry and healthy. In the spring, from the height of the land, the northerly winds often prove injurious to the blossoms of the fruit-trees, and even to the corn. The wheat, as well as the rye, is peculiarly subject to blight. The agriculture is badly conducted, although of late somewhat improved. It does not produce sufficient corn for a half year's consumption, and what is raised is of an indifferent quality. The country people are generally poor; they are clothed with coarse materials made by themselves, generally wear wooden shoes of their own fabrication, feed on buckwheat and rye, and for drink have bad cider or perry. No wine is produced within the department, nor is any beer brewed. The products of most value are hemp and flax, which grow of fine and long fibre, and the sale of them procures the requisite corn from the neighbourhood. The cattle also yield some of the means of subsistence. The breed of Norman horses is good, and the races have of late years been improved by crosses with some of greater power. Many young black cattle are bred, and many sheep, a few of which yield fine wool. The forests have been neglected, and fuel is scarce. There are mines of iron, from which about 150,000 quintals of wrought and of cast iron are yearly produced, and mostly converted into nails and other ironmongery goods. There are some fine linens made, and much pillow-lace is made by the females, with thread spun from their own flax. Those articles made from flax are the most valuable products of manufacturing industry. A few cotton goods are also made; and some leather, paper, wax, honey, and bacon, may be added to the list of products. The city of Alençon is the capital of the department, which elects four deputies to the legislative chamber.

ORNITHIÆ, a name given by the ancients to certain winds, which usually set in during the spring, at the time when the birds of passage came over to them.

ORNITHOLOGY.

History.

Ornithology, from ὄρνις, *bird*, and λόγος, *discourse*, is that department of Zoology which treats of the history and attributes of the feathered race. Birds form the second great division of the animal kingdom, being usually placed immediately after the Mammalia, and antecedent to the reptile class. They may be defined as vertebrated, oviparous animals, covered with feathers, organized for flight, and enjoying a double system of circulation and respiration; that is, their whole blood, like that of quadrupeds, must visit the lungs and return to the heart before it is propelled to the extremities,—and the entire system is provided with reservoirs of air, in addition to the lungs properly so called.

The vast extent which the science of Ornithology has acquired in recent times renders a full exposition impossible within our necessarily prescribed limits; but we shall endeavour at least to indicate the majority of the more important groups, to figure and describe in each some interesting species, and by frequent reference to such authors as have most successfully treated of the different branches in detail, enable such of our readers as desire a more elaborate view, to follow out the subject for themselves. We presume it matters not with which department we commence. Let us begin, then, with the Bibliography, which, however, need not detain us long.

Few if any important works have been transmitted to us from antiquity. In the third book of Aristotle's History of Animals (Περι Ζωων Ἱστορια, the period being about 350 years before the Christian era) we find recorded sundry observations, but brief and superficial, on the feathered race.[1] His division seems to be into such as have hooked claws, such as have separated toes, and such as are web-footed; and he observes, that the first have the breast the most robust. He describes the differences in the structure of the feet, and notices, that although the generality have three toes in front, and one behind, yet a few have only two toes in front. The bill supplies the place of lips and teeth, and passages in different parts of the head supply the place of the external organs of the senses of smell and sound. The eyes are furnished with a membrane like that possessed by lizards, but want eyelashes. No bird with hooked claws has likewise spurs upon its legs. These are a few examples of Aristotle's style of observation on the class in question.

Pliny was born about the twentieth year of the Christian era. The tenth book of his *Historia Naturalis* treats in part of birds, but in a very meagre and immethodical manner. He tells us of the raven and the phœnix, of the owl, the ibis, and the nightingale, of capons, and the cock-fights of Pergamus, and of the character and conduct of various other birds.

For 1500 years from the time of Pliny we have no recorded observations on Ornithology deserving of the reader's recollection. About the middle of the 16th century Conrad Gesner, a native of Zurich, and a noted Frenchman called Pierre Belon, each published works in part devoted to Ornithology. The writings of Gesner (*Historia Animalium*, 3 vols. folio) exhibit a cumbrous erudition, with a sprinkling of original observation, but are chiefly extracted from ancient authors. Baron Cuvier regarded him as an excellent compiler. His arrangement is alphabetical. Belon's most successful efforts were in the ichthyological department, but even in his *Historia Avium*, 1 vol. folio, 1551, we may trace an improved spirit of observation, although the basis of his classification would scarcely suffice to support a system now-a-days. He divides the class of birds into six primary divisions. 1*st*, The birds of prey, among which, misled probably by some false analogy of plumage, he includes the cuckoo. 2*d*, The Palmipedes. 3*d*, The Grallæ, including, however, the king-fisher, bee-eater, and other anomalous species. 4*th*, All the species which place their nests upon the ground, —an extraordinary bond of union, which of course brings together the pheasant, the lark, and the woodcock. Nevertheless, our author does not confound them in his lesser groups. 5*th*, The omnivorous and insectivorous birds, among which are placed the pigeons. 6*th*, The insectivorous and granivorous species, which habitually frequent shrubs and hedges.

Another noted writer of the sixteenth century was Ulysses Aldrovandi of Bologna, whose works amount to thirteen volumes folio;—the majority of them, however, were not published till after his death in 1606. The first three, which treat of birds (as well as one on insects), made their appearance in his lifetime, that is, from 1599 to 1603. They contain some amusing information, amid a vast mass of learned rubbish borrowed from his predecessors. Professor Savi, however, characterised the ornithological portion as "un monumento glorioso del suo instancabile zelo, delle sue estese cognizioni ornithologiche, e della sua universale erudizione." It is at the same time entirely deficient in scientific precision, and contains, amid much truth, a sad intermixture of unmeaning fable. The edition with which we are best acquainted is that of Bologna, 1634.

About nearly the same period a treatise was published by Gommer de Luzaney, with the title of *De l'Autourserie*, which contains some good figures of the birds of prey used in falconry. One of the earliest sketches of the history of European birds is that given by Schwenkfeld, a Prussian naturalist, in a volume entitled *Theorio-Tropheum Silesiæ*, 1603. The arrangement is alphabetical. Olina's *Uccelliera*, which contains tolerable figures of a few species not previously published, appeared at Rome in 1622. It is a small affair, restricted to the description of very few species, but contains accurate and interesting records of their history and mode of capture, as practised by the Italians, with whom *la caccia*, very different from that of Melton Moubray, is a noted passion. A swarthy, fire-eyed hunter of sixty-five is as proud of a string of dead linnets as any young Scotchman of sixteen may be of his first well-filled bag of grouse or black game.

We have next a dissertation on storks, cranes, and swallows, by J. G. Swalbacius (Spire, 1630); a natural history of Nurenberg (Antwerp, 1633); a description of the birds of the West Indies, by De Laet (Leyden, same year); a history of the birds of Brazil, by Marcgraaff (in his *Hist. Rerum Nat. Brasiliæ*, Amsterdam, 1648); and of those of Mexico, by Hernandez (in his *Nova Plant. Animal. et Min. Mexicanorum Hist.* Rome, 1651). A Scoto-Pole of the name of Johnston published about this period (some years elapsing during the completion of the various parts) his *Historia Animalium*, of which the second portion treats of birds. He is a follower, not so much of nature, as of Belon, and other authors of the pre-

[1] As in some of our preceding treatises on Natural History in this work (see, for example, the article Mammalia, vol. xiv. p. 74) we have entered at greater length into the general character of the most ancient writers, our present notices are therefore extremely slight.

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ceding century, and was himself followed by Ruysch, whose *Theatrum Universale Animalium Omnium* may be regarded as a second edition of Johnston's work. The *Natural and Medical History of the East Indies*, by Bontius, appeared in 1658, and contained descriptions of various birds at that time new. Soon afterwards Perrault, Borrichius, and Bartolinus, began to furnish the earliest modern contributions to the *anatomy* of the feathered race.

Willughby's *Ornithologia* (a posthumous work, believed to have been greatly amended and increased by Ray) was published in 1676. The first edition is in Latin, but an English translation, enlarged, made its appearance two years after. Ray's own *Synopsis Methodica Avium* (*et Piscium*) was likewise published posthumously, under the care of Dr Derham, in 1713. The writings of these authors are remarkable, as manifesting an approach to a more natural system of arrangement than had hitherto prevailed; but as they have been so frequently analysed, we deem it unnecessary to occupy our space with any detailed exposition of their views. Baron Cuvier has termed Ray "le premier véritable méthodiste pour le règne animal, guide principal de Linnæus dans cette partie." In Sir Hans Sloane's *Voyage to Jamaica*, &c. (1707–25), we have notices of various birds, accompanied by rather poor engravings; but the work was of great use to science in England, by the attention and emulation which it excited in regard to natural objects, of which the author had brought together upwards of 36,000, besides 200 volumes of preserved plants. His collections formed the original basis of the British Museum. A showy but inaccurate work by Marsilli (1726) is devoted to an interesting subject, the birds of the banks of the Danube. Albin's *Natural History of Birds*, in 3 vols. 4to (1731–38), contains above three hundred coloured figures of no great merit. Yet it was afterwards reprinted in French, with additions, at the Hague. About the same period was published Catesby's *Natural History of Carolina, Florida, and the Bahama Islands*, in 2 vols. folio, and appendix (1731–43), with numerous coloured plates of birds and other beings. Frisch's excellent work on German birds (*Vorstellung der Vogel Deutschlands*) was commenced at Berlin in 1734, and was not completed when the author died. It was continued by a stranger, and a collected edition of the whole work, with two hundred and fifty-five plates, was published in 1763. Although by no means highly finished, these engravings are accurate, and exhibit a good deal of the truth of nature. The arrangement is defective, and retrogrades from that of Ray. Seba's great, or rather large work, the *Locupletissimi rerum naturalium Thesauri accurata descriptio*, was being carried on during this period at Amsterdam, in four volumes folio (1734–65). It is unworthy of being quoted, except in reference to the plates.

By this time the illustrious reformer of systematic natural history had made his appearance as an author; the first edition of the *Systema Naturæ*, consisting of only fourteen pages folio, having been published at Leyden in 1735, when Linnæus was not more than eighteen years of age. It ran through twelve editions in little more than thirty years; the twelfth impression, the last which the author could himself revise, appearing at Stockholm in 1766–68. The influence exercised by the writings of the great Swedish naturalist is too important to admit of our proceeding farther without exhibiting a view of his classification, so far at least as concerns the feathered race. The following table presents an outline of the Linnæan arrangement of birds, which he divides into six primary groups called orders.

ORDER I. ACCIPITRES, or *birds of prey*. The bill more or less curved, the upper mandible dilated, or armed with a tooth-like process near the tip; the feet short, robust, with acute hooked claws.

Genus *Vultur*. Vultures. Beak hooked; head bare: eight species.
Falco. Eagles and hawks. Beak hooked; head feathered: thirty-two species.
Strix. Owls. Beak hooked, feathers at its base directed forwards: twelve species.
Lanius. Shrikes. Beak straightish, notched: twenty-six species.

ORDER II. PICÆ. The bill cultriform, with the back convex; the feet short, rather strong.

Genus *Psittacus*. Parrots. Beak hooked; upper mandible furnished with a cere: forty-seven species.
Rhamphastos. Toucans. Beak very large, hollow, convex, serrated; both mandibles incurved at the tip: eight species.
Buceros. Hornbills. Beak convex, curved, cultrate, large, serrated; forehead covered by a horny plate: four species.
Buphaga. Beef-eaters. Beak straight, somewhat quadrangular; the mandibles bulging: one species.
Crotophaga. Plantain-eaters. Beak compressed, half egg-shaped, arched, keeled on the back: two species.
Corvus. Crows. Beak convex, cultrate; nostrils covered by recumbent bristly feathers: nineteen species.
Coracias. Rollers. Beak conical, convex, straight, acute; upper mandible slightly longer, and indistinctly notched: twenty species.
Gracula. Grakles. Beak cultrate, convex, somewhat bare at the base: eight species.
Paradisea. Birds of Paradise. Beak covered with the downy feathers of the forehead; feathers of the sides long: three species.
Trogon. Curucuis. Beak shorter than the head, cultrate, hooked, serrated: three species.
Bucco. Barbets. Beak cultrate, laterally compressed, notched at the tip, incurved, opening to beneath the eyes: one species.
Cuculus. Cuckoos. Beak roundish; nostrils with a prominent margin: twenty-two species.
Yunx. Wrynecks. Beak roundish, sharp pointed; nostrils concave: one species.
Picus. Woodpeckers. Beak angular, straight, the tip wedge-shaped; the nostrils covered with recumbent bristly feathers: twenty-one species.
Sitta. Nut-hatches. Beak awl-shaped, roundish, straight: three species.
Todus. Todus. Beak awl-shaped, a little flattened, obtuse, straight, with spreading bristles at the base: two species.
Alcedo. King-fishers. Beak three-cornered, thick, straight, long: fifteen species.
Merops. Bee-eater. Beak curved, compressed, keeled: seven species.
Upupa. Hoopoes. Beak arcuate, convex, a little compressed, rather obtuse: three species.
Certhia. Creepers. Beak arcuate, slender, acute: twenty-five species.
Trochilus. Humming-birds. Beak slender, longer than the head, its tip tubular: twenty-two species.

ORDER III. ANSERES. Web-footed water-fowl. Bill smooth, covered with epidermis, enlarged at the tip; the toes united by a web, the legs compressed and short.

Genus *Anas*. Swans, geese, ducks. Beak lamellated at the margin, convex, obtuse: forty-five species.

Genus *Mergus*. Mergansers. Beak denticular cylindrical, the tip hooked: six species.
Alca. Auks. Beak short, compressed, convex, furrowed, the lower mandible with a prominent angle: five species.
Procellaria. Petrels. Beak a little compressed; the upper mandible hooked, the lower channelled and compressed at the tip: six species.
Diomedea. Albatrosses. Beak straight; upper mandible hooked at the tip, lower abrupt: two species.
Pelecanus. Pelicans, solan-geese, cormorants. Beak straight, the tip hooked, unguiculate: eight species.
Plotus. Darters. Beak straight, sharp-pointed, denticulate: one species.
Phaeton. Tropic birds. Beak cultrate, straight, acuminate: two species.
Colymbus. Divers. Beak slender, straight, sharp-pointed: eleven species.
Larus. Gull. Beak straight, cultrate, the tip slightly hooked, the lower mandible with an angular prominence: eleven species.
Sterna. Terns or sea-swallows. Beak slender, nearly straight, acute, compressed: seven species.
Rynchops. Skimmers. Beak straight; upper mandible much shorter, lower abruptly terminated: two species.

ORDER IV. GRALLÆ. *Waders or shore-birds.* Bill somewhat cylindrical; the feet long, bare above the tarsus, and formed for wading.

Genus *Phœnicopterus*. Flamingoes. Beak incurvated as if broken, denticulate; feet webbed: one species.
Platalea. Spoon-bills. Beak flattish, the tip dilated, rounded, and flat: three species.
Palamedea. Screamers. Beak conical; the upper mandible hooked: two species.
Mycteria. Jabiru. Beak acute; lower mandible trigonal, ascending; upper three-cornered, straight: one species.
Cancroma. Boat-bills. Beak bulging; the upper mandible resembling a boat with the keel uppermost: two species.
Ardea. Herons and cranes. Beak straight, acute, long, a little compressed, with a furrow from the nostrils to the tip: twenty-six species.
Tantalus. Ibis. Beak long, slender, arcuate; face bare: seven species.
Scolopax. Snipes and curlews. Beak long, slender, obtuse; face feathered: eighteen species.
Tringa. Sand-pipers, or shore-larks. Beak roundish, as long as the head; nostrils linear; feet with four toes: twenty-three species.
Charadrius. Plovers. Beak roundish, obtuse; feet with three toes; twelve species.
Recurvirostra. Avosets. Beak slender, recurved, pointed, the tip flexible: one species.
Hæmatopus. Oyster-catchers. Beak compressed, the tip wedge-shaped: one species.
Fulica. Coots. Beak convex; upper mandible arched over the lower, which has a prominent angle: seven species.
Parra. Jacanas. Beak roundish, rather blunt; forehead wattled; wings spurred: five species.
Rallus. Rails. Beak thicker at the base, compressed, acute: ten species.
Psophia. Trumpeter. Beak conical, convex, rather sharp; the upper mandible longer: one species.
Otis. Bustards. Beak with the upper mandible arched: four species.
Struthio. Ostrich and cassuary. Beak somewhat conical; wings unfit for flying: three species.

ORDER V. GALLINÆ. *Poultry* and other *gallinaceous birds.* Bill convex, the upper mandible arched over the lower, the nostrils arched with a cartilaginous membrane. Feet with the toes separated, and rough beneath.

Genus *Didus*. Beak contracted in the middle, with two transverse rugæ; the tip of both mandibles bent inwards: one species, now extinct.
Pavo. Pea-fowl. Head covered with feathers, those of the rump elongated, with eye-like spots: three species.
Meleagris. Turkeys. Head covered with spongy caruncles; the throat with a longitudinal membranous wattle: three species.
Crax. Curassoes. Beak with a cere at the base; head covered with recurved feathers: five species.
Phasianus. Domestic fowls and pheasants. Sides of the head bare: six species.
Numida. Guinea-fowls. Carunculated wattles on each side of the face; head with a horny crest: one species.
Tetrao. Grouse and partridges. Bare papillæ near the eyes: twenty species.

ORDER VI. PASSERES. *Passerine birds, and others.* Bill conical, sharp pointed; feet slender, the toes separated.

Genus *Columba*. Pigeons. Beak straight; nostrils with a tumid membrane: forty species.
Alauda. Larks. Beak slender, pointed; tongue slit; hind claws very long: eleven species.
Sturnus. Starlings. Beak slender, pointed; flattened towards the point: five species.
Turdus. Thrushes. Beak subulate, compressed, notched: seven species.
Ampelis. Chatterers. Beak awl-shaped, depressed at the base, notched: seven species.
Loxia. Gross-beaks, bullfinches, &c. Beak conical, bulging at the base: forty-eight species.
Emberiza. Bunting. Beak somewhat conical; lower mandible broader: twenty-four species.
Tanagra. Tanager. Beak notched, awl-shaped, conical at the base: twenty-one species.
Motacilla. Wagtails and warblers. Beak awl-shaped; tongue jagged; claw of the hind toe of moderate length: forty-nine species.
Pipra. Manakin. Beak awl-shaped, feathers at its base directed forwards; tongue abrupt: fourteen species.
Hirundo. Swallows. Beak very small, depressed at the base, incurved; the mouth wider than the head: twelve species.
Caprimulgus. Goat-suckers. Beak very small, incurved, depressed at the base; large bristles; the mouth very wide: two species.

The amount of species in the class of birds with which Linnæus had to form his system did not greatly exceed *nine hundred*. Yet with what admirable tact has he seized upon the characteristic forms which so long served as the nuclei around which so many other species were assembled! It is true that his arrangement, like all other inventions of human genius, is liable to many objections, and may not suit the subject in the wide extent acquired in recent times;—but when we see how closely his ordinal divisions accord even with the most elaborate arrangements of modern days, and how gracefully his generic groups may now be formed into more extended families, each retaining such strong affinities in its constituent parts, we the more incline to marvel at the two following circumstances;—*1st*, That Linnæus himself should have so far advanced before his age, and anticipated the labours of posterity: *2d*, that that posterity, or such portion of the same as in-

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cline not seldom to sneer at his unprecedented and even now unequalled labours, should not perceive that it is to his system they are indebted for almost all that is of any value in their own. But on this subject we shall not here enlarge.

It has been sometimes remarked, that the characters given by Linnæus to his orders are totally inapplicable to many of the species which each contains. Thus the vultures, it is said, which belong to the first order, have no projecting processes on the upper mandible; the parrots, which are referred to the second, have the bill hooked, not cultriform, and bear no resemblance to the other species; among the Anseres, which are characterised as having the bill smooth, covered with epidermis, and enlarged at the tip, are the gannets, with a bare and pointed bill, and the divers, terns, and gulls, with bills not at all answering to the description given; among the Grallæ, with a cylindrical bill, are the ostrich, with a short depressed one, the canchroma, with one resembling a boat, the spoon-bill, the heron, the flamingo, and others, the bills of which differ from each other as much as from those of the snipes and curlews; the character given to the bill of the Gallinæ agrees with that of many Passeres; and the wag-tail, the swallow, the tit-mouse, the red-breast, and numerous other small birds, have bills very different from those of the goldfinch, bunting, bullfinch, and cross-bill, which, nevertheless, are all defined under the same order, and by a similar phrase.[1] We believe the truth to be, that the more natural an order is, the greater the difficulty becomes of expressing its characters in a single line, in accordance with the briefness of the Linnæan method,—because none of these characters, taken in disconnection, remain unmodified throughout the extended series of beings which they are intended to define. There is always a blending or transition towards other groups, so that the character expressed in words must be regarded as applying in force rather to certain species which exemplify the whole, and towards which the others *tend*, than to the entire assemblage. Now the Linnæan genera are often natural as family groups, though their constituent portions may not accord with the definition; and as they become extended, or rather filled up, by the discovery of new species, the difficulty increases. Many of the modifying species, or connecting links, were totally unknown in the time of the great Swedish observer, who seized chiefly upon the more prominent and tangible points; and the necessity of forming new subdivisions in no way invalidates his claims upon the gratitude of all lovers of the *lucidus ordo*. At the same time his early disciples erred (though less grossly than many of the later renegades) in viewing all living things as merely destined to clothe with flesh and blood the gigantic frame-work which he had erected,—as if his exposition of the system of nature were in fact itself that system,—as if the highest attainments of any one, however gifted, in either art or science, were ever more than the passionate expression of some dim vision of truth, perceived through the influence of the love of knowledge. With all the lights of modern method, and the vaunted improvements in classification, see we not still "through a glass darkly?" Have not some of those who talk slightingly of the Swedish sage never contrived to see through the glass at all?

During the thirty years which elapsed between the first and twelfth editions of the *Systema Naturæ*, several important additions were made to Ornithology from other quarters. Edwards, especially, in his *Natural History of Birds, and other rare undescribed Animals*, and in his *Gleanings in Natural History*, amounting in all to seven volumes 4to (1743 and after years), made known in a rough but recognisable style, many new and interesting species. "C'est le recueil," says Cuvier, "le plus riche pour les oiseaux après les planches enluminées de Buffon." During the same period a letter was published at Pappenheim, on the birds of the Black Forest, by J. H. Zorn, *Epistola de Avibus Germaniæ, præsertim Sylvæ Hercyniæ*, which contains many excellent observations; and the correspondence was afterwards extended by Brückmann in his *Aves in Germania obviæ Epistolar. Itinerar.* cent. ii. epist. 18, and *Aves Sylvæ Hercyniæ*, ibid. epist. 17. In Anderson's *Natural History of Iceland and Greenland* (1750), we have among the earliest authentic notices of the Zoology of these northern regions. Klein and Maering each published systematic works, but based on very artificial principles, at this epoch. In Brown's *Civil and Natural History of Jamaica*, there are several ornithological contributions; and we may here name another excellent English work, Borlase's *Natural History of Cornwall*, which appeared at Oxford in 1758. In 1760 Brisson published his great systematic *Ornithologie*, in six volumes 4to, still of value for the minute though laborious exactness of the descriptions. His method is founded entirely on the form of the bill and feet, the number of the toes, and the manner in which these are united, with or without membrane, to each other. The *Ornithologia Borealis* of Brunnich appeared at Copenhagen in 1764.

The *Storia Naturale degli Uccelli*, printed at Florence in 1767, is the most extensive of all the Italian works on Ornithology, after that of Aldrovandi. It is frequently named by Temminck and other modern writers, most of whom, however, from their vague references, may be safely inferred to quote at second hand. It consists of a large collection of plates both of indigenous and exotic birds, executed with sufficient exactness, considering the slight practice which obtained in those days in the representation of natural objects. The position of most of the figures, as Signor Savi remarks, is forced and unnatural; and we may see at once that the artist was guided more by his own fancies than the accustomed observance of living nature. "Illuminatio non semper optima, nec optimus semper avium situs," are the observations made by Bœhmer.[2] The plates were engraved from drawings in the collection of a Florentine patrician, the Marchese Giovanni Gerini, a passionate lover of Ornithology, who passed much of his time in collecting, and causing to be described and figured, whatever birds he could procure from every clime and country. After his death some learned men, unfortunately not much skilled in Ornithology, supposing either that general erudition might suffice for science, or that the superficial study of a few books might compensate the want of laborious observations carried on from year to year, undertook to publish Gerini's uncompleted work, to fill up the voids which he had left, and even to alter what he had already done. They thus compiled a superficial text, in which they confused the classification, mistook the species, omitted several of the most interesting, and neglected the localities,—so that a work which, in the hands of an able editor, might have added a new glory to the already illustrious literature of Italy, became nothing more than a disorderly collection of figures. It is, however, of some value, chiefly as containing representations of species not previously known, such as *Falco cenchris, Fringilla cisalpina, Sylvia provincialis, melanocephala*, and *melanopogon, Sterna leucoptera*, &c.

From the year 1767 onwards, Pallas, in his *Spicilegia Zoologica*, the narrative of his various *Travels*, and the *Acta* of the Royal Academy of St Petersburg, contributed to Ornithology, as to most other branches of zoological science;

[1] Macgillivray's *Lives of Zoologists*, vol. i. p. 279.

[2] *Bibliotheca Scriptorum Historiæ Naturalis*, &c. tom. iii. p. 502.

and about the same time the industrious Pennant was actively engaged in his important labours. His numerous well-known works need not be here particularised. The great collection published at Nuremberg by Schligmann in 1768, though amounting to nine volumes folio, including an indifferent text, seems chiefly copied from preceding works, such as those of Catesby and Edwards. In 1770 and following years, Noseman, in conjunction with Sepp the engraver, published, in Dutch, his *History of the Birds of the Low Countries.* The concluding fasciculi are by Houttuyn. Baron Cuvier thinks the figures "remarkable for their elegance." Mr Swainson regards them as "poor and unnatural." The year 1770 is farther marked as an important epoch, by the appearance of the first two volumes of the *Histoire Naturelle des Oiseaux*, by Buffon. That illustrious writer was the first to clothe the descriptive portion of the science with colours as bright and varied as those which beautify the fairy forms of which he treats, but which had hitherto been viewed as it were only by the half-closed eye of the technical describer. The *Planches Enluminées,* afterwards published by Daubenton the younger, in illustration of Buffon's work, amount to above a thousand plates of birds, being the greatest and most important collection yet achieved in this department. In 1774 we have the *Elementa Ornithologica*, by Schœffer, whose system rests entirely on the legs and feet of birds, the primary sections being divided into *nudipedes* and *plumipedes*, while the orders and genera are determined by the number, position, and connection of the toes. He never employs the bill when he can help it; from which we may infer the nature of the work, and its probable utility to the student.

The *Voyages aux Indes*, &c. by Sonnerat (1775 and succeeding years), contains figures and descriptions of many new exotic species. Scopoli's *Introductio ad Historiam Naturalem*, published at Prague in 1777, exhibits a systematic distribution of birds, based on the form of the scales which cover the tarsi. Thus the species which, like the generality of the accipitrine kinds, parrots, the gallinæ, grallæ, and palmipedes, have those parts covered by small polygonal scales, form the section called *retepedes;* while the others, which have the tarsi protected in front by semicircular plates, bordered behind on each side by a longitudinal furrow, constitute the *scutipedes*. The general result, however, of this view is by no means successful. In 1776 Francesco Cetti published his *Uccelli di Sardigna*, a small octavo volume, containing descriptions of only a portion of the Sardinian birds, but valuable, from its notices of their habits, and the description of various new species.

Latham's *General Synopsis* commenced in 1781. However faulty in relation to the present state of the science, it was a work of great merit for its time, and contains, under not very appropriate names, by no means inaccurate descriptions of many rare birds, some of which have since been published, by more recent writers, as entirely new. Under this head we may mention both the *Index Ornithologicus* of the same author (1790), and his greatly enlarged and more modern work, the *General History of Birds*, ten volumes 4to, 1821-24, which combines the two preceding (with their supplements); but is, we regret to say, a mere combination of those rather obsolete materials, without critical discrimination, or any correction of the ancient errors. There is great increase without much progression. Nearly contemporaneous with Latham's first work, we find contributions to Ornithology by Gilius, Merrhem, and Jacquin. About 1783 Mauduit commenced the Ornithology of the *Encyclopédie Méthodique*, for which Bonnaterre formed the system of classification which accompanies the volume of indifferent plates. Of the descriptive portion an excellent modern continuation, if not completion, has been published by M. Vieillot, in three volumes 4to, 1823. Sparmann, a pupil of Linnæus, and a well-known traveller, published in 1786 the *Museum Carlsonianum*, in which several new species are represented and described. In 1787 R. L. Desfontaines (in the *Mémoires de l'Académie des Sciences*) contributed some notices of birds which frequent the coasts of Barbary; and, in the same year, Martinet, who had acted under the younger Daubenton as a superintendent of the *Planches Enluminées*, took it into his head to publish, on his own account, a collection of figures and descriptions of birds, amounting to no less than nine volumes octavo. Their number was not more alarming than their nature.

In 1789 and following years, J. F. Gmelin published the thirteenth edition of the *Systema Naturæ* of Linnæus. "Son travail," says Baron Cuvier, "tout indigeste et dénué de critique et de connaissance des choses, est cependant nécessaire, comme la seule table un peu complète de ce qui à été fait jusque vers 1790." About a volume and a half is devoted to Ornithology. White's *Journal of a Voyage to New South Wales* appeared in 1790, forming an interesting addition to the natural history of a country which still offers a vast field for zoological research; and soon afterwards Shaw announced his *Zoology of New Holland*, which advanced no farther than a few fasciculi. We have likewise in 1790 the *Fauna Gröenlandica* of Otho Fabricius, a work of great merit for the time, and still holding a high place in the estimation of the naturalist, from the accuracy of its descriptions, although in some instances the names are misapplied. In 1792 M. Beseke published in German his materials for the *Natural History of the Birds of Courland.* The works by Lord, Hayes, Lewin, and others, which appeared about this epoch, in illustration of the birds of Great Britain, were so soon afterwards superseded by the admirable and unequalled wood engravings by the inimitable Bewick, that it is scarcely necessary to bring their names to the reader's recollection. We may close our imperfect sketch of the Ornithology of the eighteenth century by the mention of Cuvier's first work, the *Tableau Elémentaire d'Histoire Naturelle* (1798), which contains the methodical distribution of birds, which he afterwards completed in his *Règne Animal.*

We may commence the present century with the title of Daudin's work, the *Traité Elémentaire et complet d'Ornithologie*, two vols. 4to, 1800. It is an unfinished compilation, of no great merit, containing only the accipitrine birds, and a portion of the Passeres. Although Le Vaillant commenced his magnificent series of ornithological illustrations during the preceding season, and continued them at intervals for several years, we shall here group together the most important, for the convenience of the reader: 1st, *Histoire Naturelle des Oiseaux de l'Afrique*, six vols. 4to, 1799-1800. The plates amount to 300, but are inferior to those of the other works of the same author. 2d, *Histoire Naturelle d'une Partie d'Oiseaux Nouveaux et Rares de l'Amérique et des Indes*, one volume 4to, 1801. This volume illustrates the *Buceridæ* or horn bills, and the *Ampelidæ* or fruit-eaters. 3d, *Histoire Naturelle des Perroquets*, 2 vols. 4to, 1801-5. Almost all the plates (139 in number) of this exquisite work are from drawings by Barrabaud, an almost unrivalled artist in the ornithological department. 4th, *Histoire Naturelle des Oiseaux de Paradis, et des Rolliers, suivie de celle des Toucans et des Barbus*, 2 vols. folio, 1806. "Equally splendid," says Mr Swainson, "with the preceding. The size and extraordinary plumage of the paradise birds require a scale fully equal to the dimensions of this volume, which exceeds any other of the author's in the beauty and splendour of its contents." We believe that the two volumes, though generally regarded as one series, were published separately, with distinct titles. 5th, *Histoire Naturelle des Promerops, et des Guépiers*, 1 vol. folio, 1807. This rare and beautiful volume

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sometimes occurs alone, sometimes as forming volume third of the preceding series. A complete collection of Le Vaillant's works forms of itself a noble *gallery* of ornithological portraits. The letter-press, more especially that of the *Oiseaux d'Afrique*, is also of great value, and will be studied with additional advantage by those familiar with the delightful narrative of his first and second Travels into the Interior of Africa, 1790–95.

As belonging to the same class of works, and also of excellent execution, may be mentioned Desmaret's *Histoire Naturelle des Tangaras, des Manakins, et des Todiers*, 1 vol. folio, 1805. M. Vieillot, who died in 1828, after a very active career in Ornithology, is the author of the following works, all of a sumptuous character, and of considerable value in their way, though inferior in beauty to those of the two preceding authors. *Histoire Naturelle des plus beaux Oiseaux Chanteurs de la Zone Torride*, 1 vol. folio, 1805;—*Histoire Naturelle des Oiseaux de l'Amérique Septentrionale*, 2 vols. folio, 1807;—*Galerie des Oiseaux*, 4 vols. 4to, 1826, an extensive series of figures, chiefly from the collection of the museum in the Garden of Plants. M. Vieillot is likewise the continuator of Audebert's *Histoire des Oiseaux dorés, ou à reflets métalliques* (2 vols. folio, commenced in 1802); and has written largely on systematic Ornithology in the *Encyclopédie Méthodique* (*Ornithologie*, by the Abbé Bonnaterre, continued by M. Vieillot, 3 vols. 4to, besides the plates, Paris, 1823); and in the *Nouveau Dictionnaire d'Histoire Naturelle.* Lastly, he indicated various new groups, or at least a variety of groups under new names, in his *Analyse d'une Nouvelle Ornithologie Elémentaire*, Paris, 1816; a work which seems to have occasioned great offence to M. Temminck,[1] and some dissatisfaction to Baron Cuvier.[2]

Alexander Wilson's admirable *American Ornithology, or Natural History of the Birds of the United States*, was published in nine volumes quarto (including Mr Ord's Supplement) between 1808–14. It still maintains its character as a work of the highest value, and although it has been since surpassed by other works in elegance of design and beauty of colouring, its descriptive or narrative portion has been scarcely equalled. Of this most remarkable production several editions have been published in America, and two in this country, viz. one by Professor Jameson, in a cheap and commodious form (four small volumes of Constable's *Miscellany*, No. 68—71, 1831), with the advantage of a systematic arrangement of the original materials,—another by Sir William Jardine (in three large 8vo volumes, 1832), with plates, and consequently of higher price, but enriched by numerous notes of great value.

We may here name the *General Zoology*, in fourteen volumes octavo, 1800–26, commenced by Dr Shaw, and concluded by Mr Stephens. The last seven volumes are devoted to Ornithology. Most of the plates are copies. Illiger's excellent *Prodromus Mammalium et Avium* was published at Berlin in one volume octavo, 1811. It establishes several new and important genera.

The first edition of the *Règne Animal* of Baron Cuvier (four vols. 8vo) appeared in 1817; the second (in five vols. 8vo) was published in 1829. We need say nothing of the surpassing excellence of a work which cast the whole subject of Zoology into a new and more natural form, nor of the unequalled labours of the illustrious author, by whom the structure and characters of so many important groups have been brought from darkness into light. The general features of his system have, with few exceptions, been steadily adhered to throughout the zoological treatises of this Encyclopædia, and (which is more to be admired) do equally pervade and illumine the labours of many modern authors who yet place themselves in opposition to his doctrines, and seem to have forgotten, or been blinded by, the dazzling source from which they drew their "golden light;" as if the false though gorgeous glory of a cloud could of itself adorn the beauty of the azure heavens,—as if the reflection of a sparkling river were any thing more than the borrowed lustre of the "Great Apollo." Let the reader rest assured, that however praise-worthy may be the skill and devotedness of our ingenious system-makers, or however valuable may be the materials which they have brought to bear upon isolated portions of nature's most majestic kingdom, they are yet separated, by the will of God, in head and hand, "longissimo intervallo," from their great master. This is no reason, but the reverse, for their ceasing to exercise their useful talents and natural powers of observation with assiduity and patience, as becomes alike the aspiring philosopher and the humble Christian;—but let no man mistake "the spirit he is of," nor suppose an owl an eagle, seeing that not in every acceptation of the phrase is it true, that "a living dog is better than a dead lion."

The natural history of the birds of Germany has been amply and successfully illustrated by the well-known works of Naumann (father and son), by those of Bechstein, and of Messrs Meyer and Wolf. We owe to M. Leisler a Supplement to the work of Bechstein (Hanau, 1812–13), and of Naumann's *Naturgeschichte der Vogel Deutschlands*, a second edition (in octavo), with beautifully coloured plates, was commenced in 1820, but has not yet attained completion. Meyer and Wolf's *Taschenbuch der Deutschen Vogelkunde* now amounts to three volumes, and is filled with excellent observations, while their large illustrated work on German birds, commenced so far back as 1804, and recently brought to a conclusion, is one of the most beautiful with which we are acquainted. M. Brehm published his *Beitrage zur Deutschen Vogelkunde* in 1820–22, in three large volumes, filled with minute details, which exhibit an accurate practical knowledge of the science. The author's views of species are peculiar. His *Lehrbuch der Naturgeschichte aller Europaischen Vogel* (two volumes) was published in the following year. In this, too, he surely describes local races, or accidental varieties, as distinct species. To M. Brehm we likewise owe several fasciculi of a work commenced in 1824, and published at intervals, under the title of *Ornis.* It consists of memoirs and memoranda, by various authors, relating chiefly to Ornithology. Lastly, we may here name his *Handbuch der Naturgeschichte aller Vogel Deutschlands* (Ilmenau, 1831), forming a goodly volume of 1100 pages octavo (with plates), which, M. Temminck remarks, may be reduced to at least one half, by suppressing the numerous indications of what the author calls *subspecies.* His system is partitioned into twenty-three orders, variously subdivided, and containing 196 genera.

Some important additions have been made of late years to the Ornithology of northern countries. The birds of Sweden are described by Professor Nilson of Lund, in his *Ornithologia Suecica*, Copenhagen, 1817–21. The same author published a *Skandinavischen Fauna* in 1824; and a much more sumptuous work appeared at Lund in 1832, under the title of *Illuminerade figurer till Skandinaviens Fauna, mit text.* The first volume contains, besides quadrupeds, seventy-five figures of birds. In 1822 M. Boié gave forth his *Tagebuch gehalten auf einer Reise durch Norwegen*, in which, along with the narrative of his travels, he furnishes many valuable observations on the

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[1] See his *Observations sur la Classification Méthodique des Oiseaux*, &c. 1817; and *Manuel d'Ornithologie*, Introduction to the second edition, p. x.

[2] *Règne Animal*, second edition, tom. i. note to Preface, p 23.

history and manners of the birds of Norway. The same author published a work under the title of *Ornithologische Beitrage*, in 1824. M. Faber's excellent little volume, the *Prodromus der Islandischen Ornithologie*, appeared in 1822. It contains most interesting accounts of the birds of Iceland, especially the aquatic kinds; and not less valuable is his later publication, *Uber das Leben der hochnordischen Vogel*, 1825, in which we have many acceptable observations on the geographical distribution, and the modes of life, of northern species. While on the subject of northern birds, we need scarcely recall to the reader's remembrance the various appendices to the *Voyages* of Captains Parry and Franklin,—Captain Sabine's *Memoir on the Birds of Greenland* (Linn. Trans. vol. xii.),—or the beautiful work by Dr Richardson and Mr Swainson on the birds of Northern America, which constitutes the second volume of the *Fauna Boreali-Americana*, 1831.

We have few systematic works devoted to the Ornithology of the more southern countries of the European continent. We are ourselves acquainted only by name with the *Ornitologia dell' Europa Meridionale* (dedicatio signata 1772), in fol. max., by Clement Bernini, a teacher of drawing. The birds of France in general are described by M. Vieillot in the corresponding portion of the *Faune Française*, an octavo work, still in course of publication; and those of Provence in particular, by M. Polydore Roux in his *Ornithologie Provençale*, 1825. Of a more general character, though not without its bearings on our present subject, is the *Histoire Naturelle de l'Europe Meridionale* by M. Risso of Nice, in five volumes 8vo, 1826. We have already had occasion to name the *Storia Naturale degli Uccelli*, published at Florence in 1767; and Cetti's more restricted one, *Gli Uccelli di Sardigna*, 1776. In more recent times (1811), Professor Bonelli of Turin published a *Catalogue des Oiseaux du Piémont*, containing two hundred and sixty-two species. In 1822, Giambatista Baseggio inserted in the twenty-eighth volume of the *Biblioteca Italiana* an enumeration of the birds observed by him in the neighbourhood of Bassano, amounting to a hundred and thirty-seven species. In 1823, Fortunato Luigi Naccari printed at Treviso his *Ornitologia Veneta, ossia Catalogo degli Uccelli della provincia di Venezia*, in which he notices two hundred and six species. In the same year Savi the younger published, at Pisa, his *Catalogo degli Uccelli della Provincia Pisana, e loro Toscana Sinonimia*. The species are classed in accordance with M. Temminck's system, and amount to two hundred and twenty. From 1819 to 1826, Professor Ranzani of Bologna gave forth his excellent *Elementi di Zoologia*, of which the third volume, consisting of nine parts, is devoted to the natural history of birds. It is, however, a general system, treating of exotic as well as of indigenous kinds; yet a good deal may be gleaned from it regarding the Italian species. A work of more special interest is the *Specchio comparativo delle Ornithologie di Roma e di Filadelfia*, by Carlo Bonaparte, commonly called the Prince of Musignano. In this slight but highly interesting volume (republished in the *Nuovo Giornale de' Letterati* of Pisa), the author compares the Ornithology of two distant regions of Europe and America, lying, however, under nearly the same latitude, and records his observations on their history and manners. Of the species of the Roman territory we had previously scarcely any knowledge, and the Prince makes us acquainted with not fewer than two hundred and forty-seven. By the same author we have also *Osservazioni sulla Seconda Edizione del Regno Animale del Baron Cuvier*, inserted in the tenth and eleventh fasciculi of the *Annali di Storia Naturale* of Bologna; and he has more recently commenced the *Iconografia della Fauna Italica*, Rome, 1832,—a sumptuous lithographic work, in large quarto, devoted to Italian zoology. Not more than half a dozen numbers have as yet appeared, and these contain but few examples of the feathered race. Though not relating to Italy, we may here mention our author's other works, viz. *American Ornithology, or the Natural History of Birds inhabiting the United States, not given by Wilson*, with coloured figures, three volumes quarto, Philadelphia, 1825–28 (only the land-birds have yet been published);—*Observations on the Nomenclature of Wilson's Ornithology*, Philadelphia, 1828;—and *Genera of North American Birds, with a Synopsis of the species found within the territory of the United States*, New York, 1828 (published in the *Annals of the Lyceum* of that city). The birds of Liguria are enumerated and briefly described, particularly the immature conditions of the plumage, by Girolamo Calvi in his *Catalogo d' Ornitologia di Genova*, 1828.

The latest but most important work with which we are acquainted on the birds of Italy, is the *Ornitologia Toscana* of Professor Savi, in three vols. 8vo, with additional synoptical tables, Pisa, 1827–31. Though more specially devoted to the birds of Tuscany, it also contains descriptions of all the other Italian species, and may be regarded as a most valuable addition to our knowledge of the feathered tribes of Europe. The southern position and delightful climate of the Italian Peninsula induce the wandering wings of many species elsewhere *raræ aves* to wend their way towards the olive groves and richly laden fig-trees of that favoured land,—thus connecting the Ornithology of Europe with that of Africa and other sultry regions.

We may be thought, in some of our preceding notices, to have entered too minutely into the enumeration of descriptive local works, but we have been guided in so doing by two considerations: 1*st*, That none of our English writers ever make any allusion to Italian Ornithology, except by casual reference to Carlo Bonaparte; and, 2*dly*, that Buffon has recorded as his opinion, that "le seul moyen d'avancer l'ornithologie historique, seroit de faire l'histoire particulière des oiseaux de chaque pays; d'abord de ceux d'une seule province, ensuite de ceux d'une province voisine, puis de ceux d'une autre plus eloignée; reunir après cela ces histoires particulières pour composer celle de tous les oiseaux d'une même climat; faire la même chose dans tous les pays et dans tous les différens climats; comparer ensuite ces histoires particulières, les combiner pour en tirer les faits, et former un corps entier de toutes ces parties separées."[1]

The *Natural History of British Birds*, by Donovan, in ten volumes octavo, is a work of no great merit. Its period of publication extends from 1799 to 1816.

To no one of our contemporaries is Ornithology more deeply indebted than to M. Temminck. His *Histoire Naturelle Générale des Pigeons et des Gallinacées*, three volumes octavo, appeared in 1813–15. The portion which concerns the pigeons was also published in folio, with beautiful coloured plates, by Madame Knipp. His *Manuel d'Ornithologie, ou Tableau Systématique des Oiseaux qui se trouvent en Europe*, 1815, consisted at first of a single octavo volume; but a greatly improved and extended edition in two volumes appeared in 1820. Whatever difference of opinion may prevail in regard to the author's system, naturalists are agreed that this is by far the most valuable work we yet possess on the birds of Europe. Its main excellence consists in the attention bestowed upon the sexual distinctions, and the successive changes of plumage from youth to age. The first volume contains, under the title of *Ana-*

[1] *Histoire Nat. des Oiseaux*, Plan de l'Ouvrage.

lyse du Système Générale d' Ornithologie, a classification of birds in general. Instead of a third edition of his *Manuel*, the author has recently published (in 1835) a third *part*, as a supplement to the first volume, and he is now about to give out a fourth *part*, or supplement to the second volume. These parts contain the corrections and additions rendered necessary by the lapse of many years. But M. Temminck has not confined his attention to the birds of Europe. In 1820 he commenced (in conjunction with M. Meiffren de Laugier) his *Planches Coloriées*, a work intended as a continuation and completion of the well-known *Planches Enluminées* of Buffon. It is printed in both a quarto and a folio form, now amounts to above ninety parts, and will be concluded (so far, at least, as the first great series is concerned) on the publication of the hundredth number. It will then form five volumes, composed in all of five hundred and ninety-five plates, exhibiting seven hundred and fifty-five figures of birds, the majority unknown to prior writers. Each plate is accompanied by corresponding letter-press, containing the generic characters, the description of the species figured, and in many instances by general observations on the distribution and construction of groups. The two concluding numbers are to contain a general index, as well as the tables and titles of the volumes. On the completion of this "century," we trust M. Temminck will be encouraged to proceed to another series, as we know his materials are abundant, if not inexhaustible. It would in truth be desirable that some such established work should be generally regarded as a proper medium for the publication of new or rare subjects in Ornithology, for it is the bane of natural history in general, that every year should be distinguished by the appearance of numerous abortive attempts, which each succeeding season condemns to oblivion. Thus the tax becomes both heavy and unproductive, yet we fear that national pride and personal vanity will long prevent the introduction of a better system. We do not mean to say that we possess not among ourselves individuals competent to do the subject justice, but assuredly there is much labour lost by a want of concentration.

In connection with the labours of the last-named author, we may here mention M. Werner's lithographic work, entitled *Atlas des Oiseaux d'Europe, pour servir de complément au Manuel d'Ornithologie de M. Temminck*, of which thirty-two livraisons have now appeared. M. Temminck had figured a few European novelties in his *Planches Coloriées*, but he appears to have remitted most of his rare indigenous kinds to M. Werner; and we are happy to find he is now in immediate communication, so far as the publication of his European species is concerned, with our zealous and intelligent countryman Mr Gould. This leads us to record the title of one of the most sumptuous and beautifully executed works within the whole range of ornithological illustration, viz. *The Birds of Europe*, by John Gould, F.L.S. now completed in five volumes royal folio. The plates are chiefly from lithograph drawings by Mrs Gould, but many are also by Mr Lear, one of the best ornithological draftsmen the world has yet seen. Mr Gould's other works, all of recent date, and of the same form and character as the preceding, are as follow:—*a Century of Birds, from the Himalaya Mountains;—a Monograph of the Toucans;—a Monograph of the Trogons;*—and, *a Synopsis of the Birds of Australia.* The latter is in a more portable form than the others; but it is the author's intention to illustrate the Ornithology of New Holland in the same mode as that in which he has treated the birds of Europe.

To M. Lesson the Ornithologist stands indebted for several publications, both of a sumptuous and useful character. The last edition of his work on humming-birds bears the following title: *Les Trochilidés, ou les colibris et les oiseaux mouches, suivi d'un index général, dans lequel sont décrites et classées méthodiquement toutes les races et espèces du genre Trochilus*, Paris, 1832, with seventy coloured plates. Conjointly with M. Garnot, he has published some figures of birds in the Zoological Atlas to Duperrey's *Voyage autour du Monde*, as well as in his own *Centurie de Zoologie*. His other works specially devoted to our present subject are,—*Manuel d' Ornithologie*, two volumes 18mo, 1829; *Traité d' Ornithologie*, two volumes 8vo (with 119 plates), 1831; and *Histoire Naturelle des Oiseaux de Paradis, des Sérieules, et des Epimaques*, one volume 8vo (with 41 coloured plates), 1835.

Mr Swainson's beautiful *Zoological Illustrations* (First Series 3 vols. 8vo, 1820–23, Second Series 3 vols. 8vo, 1832–3) contain representations of many rare and remarkable birds, and yield to none with which we are acquainted, either in elegance or accuracy. By the same author (conjointly with Dr Richardson) we have, as already noted, the *Fauna Boreali-Americana*, Part Second; and (without other aid than his own delightful pencil) several fasciculi of the *Birds of Brazil*. More recently Mr Swainson has entered into a minute as well as extended exposition of the *Natural History and Classification of Birds*, in two volumes (1836–7), which form the ornithological portion of Dr Lardner's Cyclopædia. These will amply repay the most attentive study.

The birds of South America, which, like all the productions of that splendid country, are extremely gorgeous, have been here and there illustrated in various works, and are partially so by Mr Swainson in one of those just named. In Azara's *Voyages dans l'Amérique Méridionale* (1809, 3d and 4th volumes) there are descriptions of many hundred species from Paraguay and La Plata. The ornithological portion of the French edition was translated, with notes, by Sonnini.[1] A great mass of Brazilian species is described and figured in Spix's *Avium Species Novæ*, &c. 2 vols. 4to, 1824–26; while the habits of several of the more curious birds of Demerara are recorded in Mr Waterton's eccentric and well-known *Wanderings*.

The Ornithology of North America has been illustrated in an extremely full and satisfactory manner. Indeed, of the feathered tribes of no country out of Europe, equal in extent, do we possess so ample and accurate a knowledge as we do of those of the United States. We have already mentioned the immortal work of Alexander Wilson, and its excellent continuation by Charles Lucien Bonaparte; but at present we have to record the title of a much more magnificent publication than either, we mean *The Birds of America, engraved from Drawings made in*

[1] The truly important works of Don Felix Azara seem better known to European readers by the French translations than the original Spanish publications. He devoted all his leisure hours, whilst in South America, to the pursuits of natural history, from the year 1782 to 1801. He then transmitted the manuscript of his *Apuntamientos para la Historia Natural de los Quadrupedos del Paraguay* to his brother, Don Josef Nicolas, who handed it over to a French professor, M. Moreau de Saint Méry, by whom it was translated, and published under the now well-known title of *Essai sur l'Histoire Naturelle des Quadrupèdes du Paraguay*, 2 vols. 8vo, Paris, 1801. The original, however, appeared at Madrid in the following year, with corrections and additions by the author. In 1802 he likewise published his ornithological work under the title of *Apuntamientos para la Historia Natural de los Pajaros del Paraguay y Buenos Ayres*; and this portion of his labours forms the two concluding volumes of the French translation, entitled *Voyages dans l'Amérique Méridionale de 1781 jusqu'en 1801*, 4 vols. 8vo. Paris, 1809. We are glad to understand that Mr W. Perceval Hunter proposes to publish an English translation of both works, from the original Spanish, with notes.

the United States, by John James Audubon, F. R. S., &c. 3 vols. folio, London, 1831–37; an undertaking which far exceeds in size and splendour all its predecessors in this, or indeed in any other department of Zoology. The dimensions of the work, as we have elsewhere noticed, are such as to enable the author not only to represent the largest birds of the United States, of the size and in the attitudes of living nature, but to figure a great proportion of them in family groups, so admirably conceived and skilfully executed, as really to form historical pictures of the highest interest to the general observer, and of the greatest utility to the student of Ornithology. The completion of each volume of plates is immediately followed by a large octavo volume of descriptive and general history of all the species therein contained. Mr Audubon far excels Wilson as an ornithological draftsman, and often equals him in his lively, eloquent, and interesting details of the life and manners of the feathered tribes. His descriptive volumes are entitled *Ornithological Biography, or an Account of the Habits of the Birds of the United States.* They at present amount to three in number; and a fourth and final one, to accompany the concluding fasciculus of his splendid plates, is now on the eve of publication.

An extremely useful and well-concocted work, of less ambitious form than the preceding, is the *Manual of the Ornithology of the United States and of Canada*, by Thomas Nuttall, F. L. S., in two compact octavo volumes, Cambridge and Boston, 1832–34. The author has recently returned from a scientific tour through the great western territories, including an extended range of the Rocky Mountains; and, we doubt not, the public will benefit by whatever account he gives of his researches.

Although we have hitherto confined our bibliographical notices chiefly to the works of foreign writers, we have done so not in consequence altogether of our own poverty, but rather for the more ample information of the English reader, who may be supposed to require less assistance in regard to British authors. We have scarcely even named the *British Birds* of the unequalled Bewick. We name it, and nothing more, believing that every one who delights to see nature in art, is familiarly acquainted with a work which may be keenly relished without any arduous study, but which those who study most will best appreciate and enjoy. Although the descriptive portion is written with accuracy and intelligence, we doubt not it would be advantageous to the author's family, and prove a labour of love to one or more of the many skilful Ornithologists of the present day, that the plates should be re-arranged in conformity with modern views, the supplement incorporated, the synonyms increased, and such rational alterations or additions effected, as would render it the manual of British Ornithology, if not for all time coming, yet for many future years. If accompanied by portions of the author's autobiography, so much the better. We regret that the latter, so racy and original, should have not yet seen the light. The most recent and complete edition of Bewick's Birds is that of 1832. A very beautiful preface is prefixed to the one published in 1826.

The most original *descriptive* works on the birds of Britain are Montagu's *Ornithological Dictionary*, 2 vols. 8vo, 1802, and *Supplement* to the same, 1 vol. 8vo, 1813. These were not only excellent works on *British* birds simply as such, but valuable additions to the actual history of European species,—the chief merit of many of our other publications consisting in their applying the knowledge acquired by foreign writers to our indigenous kinds; whereas Montagu rather gave than borrowed, his observations being almost entirely original. His volumes are now extremely rare in their first form; but a new edition, combining both works in one, was brought out in 1831, with notes, by Mr Rennie.

Dr Fleming, in his *History of British Animals*, one vol. octavo, 1828, enumerates and describes the birds of Britain. Of this work, which has been very useful to some who say rather too little about it, we should desire to see a new edition, remodelled in accordance with the alterations and additions rendered necessary by the lapse of years. It is a publication of great merit.

The letter-press to Mr Selby's folio *Illustrations of British Ornithology* (we mean the second edition, in two vols. 8vo, 1833) forms the best completed work we yet possess in accordance with the modern method of arrangement. Jointly with Sir William Jardine, Mr Selby has also brought out many fasciculi of *Illustrations of Ornithology* (small folio), in which are figured various interesting and curious forms of foreign species; and his well-instructed coadjutor is editor (and of several volumes author) of the *Naturalist's Library*, in which a due portion is successfully devoted to the history and representation of the feathered tribes. Both publications continue at the present time (1838).

One of the most valuable and carefully constructed works with which we are acquainted is the *Systema Avium* of Dr Wagler, pars prima, Stuttgard, 1827. It consists of a series of monographs, not in systematic order, but including several extensive and difficult genera, such as *Picus, Columba*, &c. The author unfortunately died not long ago, in consequence of a gun-shot wound accidentally inflicted by himself while sporting, and the non-completion of his work may be regarded as a great loss to Ornithologists. Various additional though detached portions of it, however, may be found in the *Isis*, a German periodical published at Frankfort. Wagler is also the author of the most recent descriptive summary of the parrot tribe, under the title of *Monographia Psittacorum*, one vol. 4to, Munchen, 1835. Our best previous treatise on that gorgeous family was published by the lamented Kuhl, in the *Nova Acta* of Bonn, vol. x. Of illustrated works on the subject, we have already mentioned that of Vaillant; and the English reader need scarcely be reminded of the extreme beauty of Mr Lear's more recent *Illustrations of the Psittacidæ*, in one vol. royal folio.

A considerable flock of ornithological authors has recently appeared above the horizon, to enlighten, however, rather than obscure our vision. We shall name a few.

Outlines of the Smaller British Birds, by R. A. Slaney, Esq. 12mo, 1833.

Familiar History of Birds, by the Rev. Edward Stanley, 2 vols. 12mo, 1835.

Manual of British Vertebrate Animals, by the Rev. Leonard Jenyns, 1 vol. 8vo, 1835.

Feathered Tribes of the British Islands, by Robert Mudie, 2 vols. 8vo, 1836.

History of the rarer British Birds, intended as a supplement to Bewick, by T. C. Eyton, Esq. 1836.

Of these, and other contemporary writers, the reader will find more ample notice in Mr Neville Wood's *Ornithologist's Text-Book* of 1836.

The following works relate particularly to the more musical of the feathered tribes: *Harmonia Ruralis, or Natural History of British Song Birds*, by James Bolton, folio, 1794;—*British Warblers*, by Robert Sweet, F. L. S. 8vo, 1823–32;—*Treatise on British Song Birds*, by Patrick Syme, Esq. 8vo, 1823;—*British Songsters*, by Neville Wood, Esq. 8vo, 1837;—*Cage Birds, their Natural History, Management*, &c. (translated from the German), by J. M. Bechstein, 12mo, 1837.

Mr Yarrell has commenced his much-desired *History of British Birds*, illustrated by a wood-cut of each species, and numerous vignettes. The illustrations are for the most part remarkably accurate as ornithological representations, and of extreme beauty in a pictorial point of view.

Structure.

From the author's excellent reputation as a naturalist, as well as from the specimens hitherto published, we should augur that this work, on its completion, will form as valuable a manual of British Ornithology as can be well desired.

Last in our list, though the reverse of lowest in our estimation, stand Mr Macgillivray's characteristic volumes, the *Rapacious Birds of Great Britain* (1836), and the *History of British Birds, Indigenous and Migratory* (vol. 1st, 1837). In regard to these two works, readers may probably differ in their appreciation of some insulated passages, critical or otherwise, not essential to the exposition of the subject in hand; but we think all must agree that they are written in a clear, vigorous, and original manner, and devoid of that vapid spirit of compilation which pervades the labours of so many of the ingenious author's predecessors and contemporaries.

We shall not here enter into any detailed exposition of the internal structure of birds. Our space would not admit of our doing so in a manner likely either to satisfy ourselves or to instruct our readers. The subject is of too great importance to be superficially treated, and a deeper scientific examination is not to be looked for here. We regret to say, there is much reason to accuse the naturalist of confining his attention to the external characters of living beings, which, though important portions of the animal economy, are nevertheless only portions, though too often looked upon as all in all. It is no reason for neglecting the internal structure, that a knowledge of such structure is not required to comprehend the modern systems. This, we must admit, is true; but the systems are thereby so much the more defective. An assured anatomical basis will never cause confusion or contrariety in any *good* arrangement formed on the groundwork of external characters; for the best of these are sure to conform themselves with all the important modifications of internal structure, while the sooner a bad arrangement is undermined the better. At the same time, that Zootomist would know little of the practical importance of external forms who should not endeavour to connect these with his demonstration of more recondite characters. In truth, however desirable it may be to know the whole of the animal structure, whether external or internal, we must in relation to museum specimens and to zoological collections in general, necessarily have recourse to superficial, or at least external characters, because none other are visible, or indeed exist, in the subjects of natural history as usually preserved; and we should debar a vast multitude from a most delightful study of graceful forms and gorgeous plumage, if we could learn nothing important of beast or bird without prying into all the hidden wonders of its interior. Whatever progress comparative anatomy may in future make, we trust the Zootomist will ever bear in mind that the establishment of good external characters is a matter of the highest and most indispensable importance to the present state and future progress of natural history, of which the practical pursuit will ever mainly depend upon the class of characters in question. As we cannot here enter into the anatomical department of our subject, we shall give, in the subjoined note, the names of a few works likely to interest and instruct the reader.[1] A few paragraphs will suffice for all we have ourselves to say, before entering upon our systematic portion.

The bill, composed of the upper and under mandible, varies almost infinitely in its form in the different genera, in the determination and construction of which it affords characters of the highest importance. As its modifications will be specially alluded to in our notices of the minor groups, and are moreover accurately represented in the plates which accompany the present treatise, we need not here fatigue the reader by an unnecessary enumeration. A portion at the base of the upper mandible, usually containing the nostrils, and sometimes covered with hairs or feathers, sometimes partially or entirely bare, is called the *cere*. It is very obvious in most birds of prey, but imperceptible in many other species. When we expand the mandibles, we of course perceive the opening to the alimentary canal or digestive organs, which usually consist of the following portions.

The *pharynx* follows immediately after the cavity of the mouth. It leads into the *œsophagus* or gullet, which in many species swells into what is called the *crop*, by some regarded as the first stomach. This is followed by a second enlargement, produced, however, rather by a thickening of the coats than by any increase of capacity within, named the *proventriculus*. It contains numerous glandular sacs interposed between its muscular and mucous coats, which secrete a gastric juice to aid the process of digestion. This proventriculus leads to the *gizzard* or true stomach, by some regarded as the third stomachic expansion. Here the function of digestion is completed. The entrance from the stomach to the small intestine is named the *pylorus*, of which the structure is frequently valvular. The first fold of the small intestine is named the *duodenum*, and after receiving the pancreatic and biliary ducts, it forms various convolutions, and terminates in the rectum or large intestine. The *cœca* are usually placed at the commencement of the latter; its termination is named the *cloaca*.

These parts, it will be borne in mind, are variously modified in the different tribes. In some the expansion called the crop is wanting, or not to be distinguished from the other upper portions of the œsophagus; and the powerful muscles which constitute the peculiar strength of the gizzard in granivorous birds are very feeble in the carnivorous and fish-devouring kinds. In some the intestine is long and narrow, in others short and wide, while the cœca exhibit a corresponding range, being in certain kinds extremely long, in others merely rudimentary.

Birds are remarkable for the energy of their respiratory functions. Although their lungs are rather small, they are perforated in such a way as to communicate with membranous cells distributed through various parts of the body, and even communicating with the interior of the bones, so that the atmospheric air not only comes in contact with the pulmonary vessels, but with a great proportion of the circulating system. Thus birds have been said to respire by the branches of the aorta, as well as by those of the pulmonary artery. It is thus that the most rapid exercise of the faculty of flight impairs not their power of breathing; and the best-trained hunter that ever bounded rejoicingly over the fences of Leicestershire is far sooner blown than a field sparrow.

The *trachea* or wind-pipe is composed of bony rings. The *upper larynx* is of comparatively simple structure, and of less importance than among the mammiferous class; but farther down, and close upon the bifurcation of the trachea, is the *lower larynx*, the true organ of the voice in birds. The vast bulk of air contained in the interior cells no doubt contributes to the strength of their vocal powers, while the muscles of the inferior portion of the larynx, and

[1] Cuvier's *Leçons d'Anatomie Comparée*; Carus's *Introduction to Comparative Anatomy*, translated from the German by Mr Gore (there is a better and more recent French edition of this work); Meckel's *Traité Général d'Anatomie Comparée*; Grant's *Outlines of Comparative Anatomy*; Mr Owen's article AVES, in Todd's *Cyclopædia of Anatomy and Physiology*; and the *Introduction* to Macgillivray's *History of British Birds*, vol. i.

Structure.

the length, diversified form, and varied movements of that organ, bestow upon it a great facility of modulation.

The anterior limbs of birds, corresponding to the fore legs of quadrupeds, have been converted into wings for the purposes of that aërial locomotion commonly called flight. It is true that some birds cannot fly, that is, leave not the surface of the earth; but these are exceptions to the general rule, and even among such exceptions the great majority use their wings as a propelling power, whether coursing amid dry and barren deserts, or submerged beneath the waves. The bony portions of the wings consist of the *humerus*, the *cubitus*, the *carpal* and *metacarpal* bones, and *fingers*. We shall briefly describe these parts in so far as they are connected with the imposition of the plumage, and consequently with the external characters of the feathered race. The reader, if he so inclines, may here consult Plate CCCLXXXVII. figs. 3 and 4. The *humerus* or armbone (*c*) is joined to the body by means of a part of its own upper surface, which articulates with a corresponding cavity between the coracoid bone (*b*) and the scapula or shoulder-blade (*a*). It is directed backwards in repose, and in a position more or less parallel with the spine. The other extremity of the humerus articulates with the *cubitus* or fore-arm, which is composed of the bones called the *ulna* (*d*) and *radius* (*e*), and is so jointed as to fold when at rest in a direction parallel to that of the arm. The *carpus* consists of two small bones (*f f*) placed between the outer extremity of the cubitus and the *metacarpus*. The latter (*g*) usually consists of two bones united at both ends. From the anterior edge of the portion next the carpus, there projects a small bone, considered as analogous to the first digit or thumb, *pollex* (*h*); to the extremity of the outer portion of the metacarpus are usually attached two other digital bones (*i j*); and to the extremity of its inner portion is frequently appended a smaller bone of corresponding nature. These are the *fingers* of birds.

Now, the connection of the *plumage* with the preceding parts is as follows. Here consult Plate CCCLXXXVII. figs. 1, 2, 5. The small elongated tuft of stiffish feathers which clothe the upper exterior margin of a bird's wing, increasing in size downwards, pointing towards the base of the outer primaries, and commonly called the *alula*, or spurious wing (see S. W. in figs. 1, 2, and 5), springs from the portion we have called the thumb. The *primaries* or greater quill-feathers of the wings, that is, the *ten* outermost feathers, and which constitute the more or less pointed terminal portion (see figs. 1, 1 to 10, and figs. 2 and 5, at P. P.), spring from the digital and metacarpal bones. The *secondaries*, or lesser quill-feathers (figs. 1, 1 to 6, and figs. 2 and 5, at S. S.), which, when the wing is closed, usually cover a portion of the primaries, take their origin from the cubitus or fore-arm; while a third series, inconspicuous in most birds, though very obvious in others, and named the *tertials* or tertiary feathers (fig. 2, T. T.), are derived from the humerus or arm bone. Above these, and lying over that portion of the wing which joins the body (or, as it were, between the wing and back), are the *scapulars* (fig. 2, Sc.), usually of an elongated form, and often distinguished from the surrounding plumage by a difference of tint or marking. Lastly, various ranges of feathers which clothe the upper portion of the wings from the carpal joint backwards, covering the base of the primary and secondary quills, and spreading across from the spurious wing to the scapulars, are named the *wing coverts*, and are distinguished, according to their position, as the smaller coverts (figs. 1 and 2, Sm. C.), which clothe the upper portion of the wing; the secondary coverts (figs 1 and 2, at S. C.), which protect the base of the secondaries; and the primary coverts, (figs. 1 and 2, at P. C.), which perform that office to the primaries. The feathers which clothe the under surface of the wings are named the *under coverts* of those parts; and the terms *upper* and *under tail-coverts* signify the feathers which cover the base of the tail, above or below. But we need scarcely occupy our pages with the numerous particulars which might be brought forward, and which occupy so prominent a space in many ornithological volumes. The terms in most cases explain themselves. When we speak of the crest of a bird, we of course mean to indicate the feathers on its head; and the upper, central, or lower portions of the back, can be respectively nothing more nor less than one or other of these portions. When we mention the point of the bill, we literally mean the point, and there is no word in the English nor in any other language which can express it more clearly. Neither do we think it necessary, in an English work, to give a corresponding Latin phrase for every term we use, more especially as many of these terms cannot be correctly Latinized, and in fact have never occurred at all in any books in that language. Their confinement, therefore, in a circumflexual prison, amid the unembarrassed freedom of the English tongue, is a sad and cruel mockery "of things attempted yet in prose or rhyme;" and we believe is but seldom practised by those who got through Ruddiman respectably in early life. We therefore deem it worse than useless to present an endless catalogue of *terms in Ornithology*, followed by explanations more obscure and ambiguous than the technicalities themselves; but shall rather endeavour either altogether to avoid unknown tongues, or, by the context, to render our meaning obvious to each capacity.[1]

Those minute discriminations, so often insisted on, are in truth but seldom necessary in the description of a bird's external aspect, especially of its feathered portions, because large spaces of the plumage have frequently an identical character both in texture and colour. Thus, if the entire head is either black, white, brown, or any other single colour, it would be a waste of words to describe it in any other way than simply as being of that colour; that is, it would be unnecessary to say that the frontal, vertical, occipital, auricular, and ocular feathers of the head were coloured after such a fashion; but if one colour prevails over another, and yet is traversed, or in any way varied by other colours, the precise region, whether frontal or occipital, in which the variation happens should be stated. We would almost say, that our nomenclature of the parts themselves depends to some extent on the distribution of the colours. Thus, of birds with a black abdomen and a scarlet breast, we can easily conceive, that even of the same species two individuals may so considerably differ in the proportional extent of the supposed colours, that the black in one instance shall encroach upon what corresponds to the scarlet of the other, or *vice versa*; but still the phrases "abdomen black, breast scarlet," would suffice for both, though not proportionally the same in each. The fact is, that many of the special regions of a bird are by no means precisely marked, or at least are seldom seen to be so, unless we strip it of its plumage,—an untoward act, however, for one who desires to stuff or otherwise preserve its skin; and therefore some latitude must be allowed in our expression of the external parts.

The next portion to be briefly described is the leg or hinder limb. This is divisible into the *femur*, *tibia*, *tarsus*, and *toes*. See Plate CCCLXXXVII. fig. 3.

The *femur*, or thigh-bone (*k*), is cylindrical, somewhat

[1] A very ample and interesting account of the diversified form of bills, feet, and feathers, will be found in Mr Swainson's *Natural History and Classification of Birds*, vol. i, illustrated by numerous wood-cuts from the elegant pencil of the author.

Structure curved, usually very short, and always so concealed within the body as not to be apparent as an external portion of the limb. The next division is the leg or *tibia* (*m*), frequently but erroneously called the thigh, probably from its being the uppermost apparent portion. It is usually covered with feathers, though sometimes bare on its lower portion. Then follows the *tarsus* (*n*), that long, slender, exposed portion, so conspicuous in almost all the species, varying considerably among accipitrine birds, rather short in web-footed water-fowl, and greatly lengthened in the majority of shore-birds or waders. Its upper knobby portion, where it articulates with the tibia, is the true heel, although generally in colloquial, and not seldom in descriptive language, termed the knee. The prominences of its lower extremity articulate with the *toes*. The latter parts usually amount to four; the hind toe, however, is wanting in many species, and the ostrich is generally supposed to have only two toes, although Dr Riley has demonstrated the existence in that bird also of a rudimentary inner toe. The hind toe is by some regarded as the first, the inner as the second, the middle as the third, and the outer as the fourth toe; and in this order there is a progressive increase in the number of the joints of which each is composed,—the first having two, the second three, the third four, and the fourth five bones. The surface of the tarsus, toes, and sometimes of the base of the tibia when that part is exposed, is covered either with plated or reticulated scales, of various forms in different species; and the tarsus is moreover often armed with one or more spurs,—which, however, belong to the cutaneous rather than the osseous system. A general notion of the latter, as it exists in the class of birds, may be acquired by an inspection of the skeleton of the golden eagle just referred to (Plate CCCLXXXVII. fig. 3). We shall here add nothing more upon the subject.

The position, and therefore to a certain extent the nature, of many modern genera, of which we are unable from want of space to give the characters, will be seen in the tabular views with which we terminate the present treatise. A considerable discordance still prevails in regard to the nature and amount of the generic groups in Ornithology,—some writers advocating a numerous subdivision, and consequent restriction, of characters; while others adhere, perhaps too tenaciously, to old associations, which naturally tend to the augmentation of species, in other words, to the extension rather than the increase of genera. The former plan is rendered necessary to a great extent by the vast additions which have been made to our knowledge of groups and of typical species within the present century, and might be deemed advisable among the larger genera even as a mere matter of convenience;—its abuse in the hands of unskilful or inexperienced persons being of course no legitimate argument against it. There is, however, a great deal that is arbitrary and unsettled in whatever principle may be supposed to guide the modern naturalist in the formation of his generic groups. The simplicity and ease of application which characterised the former artificial systems have been lost in their attempted demolition, while the reconstructions now arising (in spite of the abundant though not always acknowledged appropriation of some useful old materials) are not yet so complete and commodious as to afford the same accommodation to the benighted student. Order will no doubt some day spring from chaos, and even already, amid the darkness of the upheaving waters, are many sunny spots of terra firma towards which we fondly steer, "well pleased that now our sea should find a shore." Naturalists, however, need by no means quarrel with each other, as if there was a certain good to gain, or some great physical truth to be established. "All the great business of genera and species," says Locke, "amounts to no more but this, that men make abstract ideas, and, setting them in their minds with names annexed to them, do thereby enable themselves to consider things, and discourse of them, as it were in bundles, for the easier and readier improvement and communication of their knowledge, which would advance but slowly were their words and thoughts confined only to particulars." "The reason," he says again, "why I take so particular notice of this is, that we may not be mistaken about genera and species, and their essences, as if they were things regularly and constantly made by nature, and had a real existence in things,—when they appear upon a more wary survey to be nothing else but an artifice of the understanding, for the easier signifying such collections of ideas, as it should often have occasion to communicate by one general term, under which divers particulars, as far forth as they agreed to that abstract idea, might be comprehended."

Genera.

The following observations by Mr Vigors may be introduced with propriety in this place, as according closely with our own views on the subject of generic divisions. "But though nature nowhere exhibits an absolute division between her various groups, she yet displays sufficiently distinctive characters to enable us to arrange them into conterminous assemblages, and to retain each assemblage, at least in idea, separate from the rest. It is not, however, at the point of junction between it and its adjoining groups that I look for the distinctive character. There, as M. Temminck justly observes, it is not to be found. It is at that central point which is most remote from the ideal point of junction on each side, and where the characteristic peculiarities of the groups, gradually unfolding themselves, appear in their full development; it is at that spot, in short, where the typical character is most conspicuous, that I fix my exclusive attention. Upon these typical eminences I plant those banners of distinction, round which corresponding species may congregate as they more or less approach the types of each. In my pursuit of nature, I am accustomed to look upon the great series in which her productions insensibly pass into each other, with similar feelings to those with which I contemplate some of those beautiful pieces of natural scenery, where the grounds swell out in a diversified interchange of valley and elevation. Here, although I can detect no breach in that undulating outline over which the eye delights to glide without interruption, I can still give a separate existence in idea to every elevation before me, and assign it a separate name. It is upon the points of eminence in each that I fix my attention, and it is these points I compare together, regardless, in my divisions, of the lower grounds which imperceptibly meet at the base. Thus also it is that I fix upon the typical eminences that rise most conspicuously above that continued outline in which nature disposes her living groups. These afford me sufficient prominency of character for my ideal divisions; for ideal they must be, where nature shows none. And thus it is that I can conceive my groups to be at once separate and united; separate at their typical elevations but united at their basal extremes.

"It is difficult to convey, in terms sufficiently explicit an accurate definition of abstract notions like the present. We may see the subject clearly ourselves, but not be able to communicate it by words sufficiently intelligible, unless to those who may happen to view it in the same light as ourselves. I shall therefore take a familiar illustration which comes home to the feelings of every man, and where it will be immediately apparent that strongly marked divisional groups may be kept apart from each other in our conceptions, although we can recognise no absolute boundary lines by which we can say they are separated.

"Let us take, for instance, that period of time which in volves the annual revolution of the earth round the sun, and let us divide it into the usual departments which we call seasons. Every man can picture to his own mind the decided characters by which these divisions of the year are parted from each other; he can mark out by definite distinctions those striking periods where the year bursts forth into bud, where it opens into flower, where it ripens into fruit, and where it lapses into decay. He can ascertain the nature of the impressions which each season forces upon his own feelings, he can communicate such sensations to others, and he can embody those natural periods, of whose separate existence he feels conscious, into separate and well-characterised divisions, to which he can refer, without fear of being misunderstood, under the distinct appellations of spring or summer, of autumn or of winter. But can he at the same time point out the actual limits of these natural departments of the year? Can he fix, for instance, in that intervening interchange of season, where the rigour of winter silently and imperceptibly relaxes into the mildness of spring,—can he fix, I say, upon the exact period when the former terminates, and the latter begins? Can he assert at one moment that he is within the precincts of one season, and that, even while he speaks, he has passed into the confines of the other. He may, it is true, assign artificial limits to each department, and may calculate with mathematical precision the months, the days, the hours, of which it consists. He may even assign reasons for his arbitrary divisions, and prove their probable approximation to the regular interchange of nature. And this is precisely as far as the Zoologist can go. But this is all that is in his power. He never can feel or assert that the character of one season is lost at one particular moment, and gives place to the character of that which succeeds. Here, then, we have four decided divisions, perfectly distinct in themselves, yet to which we are unable to affix the limits. So it is with the groups of Zoology. They exhibit separate divisions, distinguished by separate characters, but running into each other without any assignable limits; and any man may draw his imaginary line across that 'border country,' that 'land debateable,' which stretches between the conterminous regions, according as it suits his fancy or his peculiar views, or as it may accord with the greater or less preponderance of those minor landmarks which serve as an inferior mode of demarcation in the absence of all natural boundaries."[1]

We shall now proceed with our proposed exposition of the various orders.

Order I.—RAPTORES, OR BIRDS OF PREY.[2]

Raptorial birds, under which term we include the tribes usually known by the general names of vultures, eagles, hawks, buzzards, kites, and owls, are distinguished by a strong, sharp-edged, acutely-pointed bill, more or less curved, but always hooked at the extremity of the upper mandible, which is covered at the base by the membrane called the cere. The nostrils are usually open. The legs, with few exceptions, are plumed as far as the top of the tarsus; the latter part itself is usually bare, but is entirely covered with feathers in most of the nocturnal kinds, and partially so in several of the diurnal. The toes are always four in number, very free in their movements, the outer sometimes versatile; and the whole, with rare exceptions, are furnished with strong, sharp, curved, prehensile claws.

All raptorial birds feed on animal substances,—the majority on living prey. Representing in their own class the ferine species among quadrupeds, they subdue their weaker brethren by force more frequently than guile; and if not more tyrannical than tigers, they at least exercise a more extended sway, for the fields, the woods, and waters, the barren mountains, and resounding shore, are all alike subjected to their fierce control. Their power of flight is remarkable for its surpassing strength and long endurance. They occur in some form or other under every clime, and their external aspect varies greatly, both in size and shape, from the ponderous eagle and condor of long extended wing, to the finch-falcon of Bengal, which is scarcely larger than a sparrow. But, generally speaking, raptorial birds are of considerable bulk, as might be anticipated from the necessity under which they lie of subduing an active and not always unresisting prey. Their forms, however, are often graceful, their actions energetic, their eyes bold and bright, and their plumage beautifully varied;—but they are more remarkable for chaste and subdued colouring, for sober shades of intermingled black and brown, than for those brilliant or gorgeous hues which characterise so many of the feathered tribes.

Their dispositions naturally fierce or unaccommodating, if not contentious, their ravening appetites, and dangerous weapons, induce them but seldom to associate with each other. We shall not here describe them, after the manner of many authors, as gloomy and mistrustful,—for what cause has an eagle, rejoicing in his strength, and winging his way from distant isles o'er waters glittering with redundant life, or hovering on the side of some majestic mountain, of which the purple heath is one wide storehouse of the best of game,—what cause has he for gloom? Or why should he mistrust, whose sail-broad vans might almost carry him across the vast Atlantic, or assuredly in a few brief hours transport him from his bold but barren eyrie, to richer pastures, reverberating with the varied voices of defenceless flocks? We believe there is nothing mournful or disconsolate in beings which pursue the unfettered exercise of natural instinct. Such fearful attributes are but reflections from the melancholy mind of man (whose morbid *reason* often casts a gloom across the brightest sun), but cloud not in reality the face of nature. Birds of prey, however, are not gregarious,—although, "where the carcass is, there will the eagles be gathered together." For eagles we presume to read vultures, the scavengers of the raptorial order, which in sultry regions are highly useful in clearing all decaying offal from the earth. With these exceptions, the others may be said to dwell in single pairs,—at times in solitude. They build their rude but sufficing nests amid precipitous rocks, on ancient ruins, and occasionally among forest trees, while a few take up their station on the ground. They seldom lay more than four eggs, and many only rear a pair of young. These are at first extremely helpless, and covered for a time with down. The females, in the generality of species, are considerably larger than the males. The plumage of the sexes often differs greatly, and in such cases the offspring for one or more seasons resembles the mother.

The voice in the raptorial order is almost always harsh and unmusical, sometimes more plaintive in the hooting kinds, complaining by night from ivy-mantled tower or ancient tree; and only one species, a hawk from Africa, has been ever said to sing. The uses to the human race of birds of prey are not remarkable. The scavengers above alluded to are beneficial in their way, but the same can scarcely be alleged of such as carry off our lambs or poultry; and we are not aware that either their flesh or feathers are of much avail. More might have been said of certain members of the order, had not the practice of

[1] *Zoological Journal*, No. ii. p. 196.

[2] Accipitres, Linn.; Rapaces, Temm.

Raptores.

falconry, with other chivalrous uses, been about to pass away.

SECT. I.—DIURNAL BIRDS OF PREY.

Cere usually naked, or partly covered by setaceous feathers. Nostrils open. Eyes of medium size, lateral. Head rather small, and elongated; face not surrounded by a completed disk of projecting feathers, as in owls. Sternum strong and solid. Stomach membranous. Intestines not greatly extended. Cæca short. Toes naked.

Of this section Linnæus and the other naturalists formed only two genera, *Vultur* and *Falco*, which some regard as forming two large families, subdivided into numerous minor groups. There is, upon the whole, a well-marked character, or at least a strong physiognomical distinction, between the *Vulturidæ* and *Falconidæ;* but this is more easily seen than expressed, or, when expressed, is often erroneously so. Thus a strong alleged distinction is the nearly naked head of the former; but the lammer-geyer (*G. barbatus*) has that part as densely plumed as any eagle. However, the nails are generally blunt, and the feet comparatively feeble.

FAMILY I.—VULTURIDÆ.[1]

The birds of this family are of large size and gluttonous habits. They prefer animal substances in a state of decomposition to living prey, and are frequently gregarious. The bill is never notched, and the feet and claws are more feeble and less curved than among the Falconidæ. Though indolent, especially after meal time, they are distinguished by great powers of flight. Their bodies in repose assume a more or less horizontal position. Their flesh is disgusting as an article of food, but their down has been occasionally made use of for domestic purposes.

Genus Vultur, Cuv. Bill large and strong, compressed, straight at the base, convex and rounded at the point. Nostrils naked, rounded, obliquely pierced. Head and neck bare of ordinary feathers, but covered by a short down. A collar of long soft feathers at the base of the neck.

The true vultures, as now restricted, belong to the ancient world. Their flight, though slow, is powerful and long sustained. They frequently rise, by repeated gyrations, to a great height in the air, and descend in a similar manner. They assemble in troops, and feed for the most part on carcasses; yet the Dalmatian shepherds are said to dread their inroads among their sheep and lambs. They build among inaccessible rocks, and feed their young by emptying the unsavoury contents of their own crops. It does not appear that they can transfix or carry off their prey by means of their talons, as do hawks and eagles.

We have two species in Europe, the cinereous vulture (*V. cinereus*, Linn. Plate CCCLXXXVIII. fig. 1), called *arrian* on the Pyrenees, and the *griffon* or fulvous vulture (*V. fulvus*, Linn.). Both birds occur in Spain and the Tyrol, but are scarcely ever seen in Switzerland, and are rare in Germany. The nidification of the cinereous vulture is still unknown. It probably never breeds in Europe, but rather in the mountainous countries of Asia, where it is known to occur abundantly. The fulvous vulture is more courageous than the preceding, and more inclined to seize on living prey. It is common in the neighbourhood of Gibraltar, abounds in Dalmatia during winter, and has been observed to breed in Sardinia on lofty trees. It lays two eggs, of a greenish white, with a rugose surface. It is widely spread over the continent of Africa. Several other species are found in the warmer regions of the old world.

Genus Sarcoramphus, Dumeril.[2] Bill thick, straight from the base, but strongly curved at the extremity, the margin of the upper mandible having a somewhat sinuous or S-like outline. Nostrils longitudinal and oblong. Head and neck bare, wattled, surmounted by a fleshy crest.

This genus is confined to America, and consists of three species, the famous condor of the Andes (*S. condor*), the king-vulture (*S. papa*), and the Californian vulture (*S. californianus*). The condor inhabits the loftiest of the Andes, and in its aërial flights is supposed to attain to a station far above that of every other living creature. According to Humboldt, it soars to an elevation nearly six times greater than that at which clouds are usually suspended in the sky. At the vast height of almost six perpendicular miles, the condor is seen majestically sailing through the ethereal space, watchfully surveying the airy depth in quest of his accustomed prey. When impelled by hunger, he descends to the nearest plains which border on the Cordilleras; but his sojourn there is brief, as he seems instinctively to prefer the desolate and lofty mountains. The barometer amid such aërial haunts attains only to the height of sixteen inches. These rocky eyries (of which the plain is elevated about 15,000 feet above the level of the sea) are known vernacularly by the name of *condor nests.* There, perched in dreary solitude, on the crests of scattered peaks, at the very verge of the region of perpetual snow, these dark gigantic birds are seen silently reposing like melancholy spectres. Hardly an instance is known of their assaulting even an infant, though many credulous travellers have given accounts of their killing young persons of ten or twelve years of age.[3]

The history of the condor, like that of its Patagonian neighbours of the human race, has in fact been much obscured by exaggeration. An inspection of its feet and claws suffices to show that it is not gifted with great prehensile power, and could scarcely carry off the most ill-conditioned child, though not seldom accused of such evil practices. Condamine informs us that he has often seen condors hovering over flocks of sheep, some of which they "would have carried away, had they not been scared by the shepherds;" and this vague supposition is stated as a *fact* in their natural history! It is a bird of powerful wing, but of vulturine habits, feeding much on dead animal matter, but not unfrequently joining together in the attack of cattle, especially of such as are in any way enfeebled. Although the usual station of the condor is mountainous, it often descends, as we have said, to feed among the plains and valleys; and a female, now in the French museum, was found at sea, sitting on the dead body of a floating whale. It breeds amid the inaccessible peaks of the Andes, making no nest, but depositing its eggs upon the arid rock. It is a large bird, of from three to four feet in length, with an extent of wing very variously stated, but probably sometimes reaching from ten to twelve feet. The female is of a much browner hue, and wants the caruncles. She is less in size than the male, an unusual circumstance in this order, although we suspect that the greater bulk of that sex is a feature chiefly characteristic of the hawks and eagles.

"In riding along the plain," says Sir Francis Head, "I passed a dead horse, about which were forty or fifty condors; many of them were gorged and unable to fly; several were standing on the ground devouring the carcass;

[1] On the modern groups into which this family is divisible, the reader may consult a paper by Mr Vigors in the *Zoological Journal*, No. viii. p. 368.

[2] *Vultur*, Linn. Cuv.; *Cathartes*, Illiger, Temm.

[3] Nuttall's *Manual of Ornithology*, i. p. 36.

the rest hovering above it. I rode within twenty yards of them; one of the largest of the birds was standing with one foot on the ground, and the other on the horse's body; display of muscular strength as he lifted the flesh, and tore off great pieces, sometimes shaking his head and pulling with his beak, and sometimes pushing with his leg. Got to Mendoza, and went to bed. Wakened by one of my party who arrived; he told me, that seeing the condors hovering in the air, and knowing that several of them would be gorged,[1] he had also ridden up to the dead horse, and that as one of these enormous birds flew about fifty yards off, and was unable to go any farther, he rode up to him; and then, jumping off his horse, seized him by the neck. The contest was extraordinary, and the rencontre unexpected. No two animals can well be imagined less likely to meet than a Cornish miner and a condor, and few could have calculated, a year ago, when the one was hovering high above the snowy pinnacles of the Cordillera, and the other many fathoms beneath the surface of the ground in Cornwall, that they would ever meet to wrestle and 'hug' upon the wide desert plain of Villa-Vicencia. My companion said he had never had such a battle in his life; that he put his knee upon the bird's breast, and tried with all his strength to twist his neck; but that the condor, objecting to this, struggled violently, and that also, as several others were flying over his head, he expected they would attack him. He said, that at last he succeeded in killing his antagonist, and with great pride he showed me the large feathers from his wings; but when the third horseman came in, he told us he had found the condor in the path, but not quite dead."[2]

The king-vulture, *S. papa* (Plate CCCLXXXVIII. fig. 3), is a much more gaily adorned species, the fleshy portions of its head and neck being red, orange, and purple. The upper parts of the plumage are of a pale reddish-white or clay colour, the collar at the base of the neck is bluish-gray, the quill-feathers and tail black (the former with paler edgings), and the under parts of the body white. This beautiful bird is found in America, from the 30th degree of north latitude, to about the 32d in the southern hemisphere; that is, it occurs in Mexico, Paraguay, Guiana, Brazil, and Peru; but most abundantly beneath the torrid zone. According to Azara, it makes its nest in hollow trees, and lays two eggs. It is supposed to derive its name from its habit of driving off the common vultures of America, called turkey buzzards, from their prey. The female king-vulture is of somewhat smaller size than the male. The ruff, and all the upper parts of her plumage, are brownish black, and her bill is destitute of caruncles.

Genus Cathartes, Illiger. Bill much more slender than in the preceding genera; the upper mandible inflated above the nostrils, encroaching as it were upon the forehead, curved at the point, the margins nearly straight; the under mandible slender, slightly inflated, and obtuse at the terminal portion. Cere extended. Nostrils broad, quadrangular, longitudinal, very open. Head and neck naked, without caruncles. Tongue fleshy, fringed. Tarsi naked, rather feeble; claws short, curved, blunt. Tail-feathers twelve.

This genus, as now restricted, is likewise confined to America. It consists of two species, the common turkey buzzard (so called in the United States), *C. aura*, Plate CCCLXXXVIII. fig. 2, and the carrion-crow (of the same country), *C. atratus*. The former is abundant both in North and South America, and extends, in the central districts of the fur-countries, as far north as the 54th degree. It is partially migratory, even in the middle states, retiring southwards on the approach of winter. A few remain throughout the year in Maryland, Delaware, and New Jersey; but none are known to breed in any of the Atlantic States to the north of the one last named. In the interior, however, they reach a much higher latitude during their summer migrations, probably owing to the greater heat of that season in the inland districts. A few make their appearance on the banks of the Saskatchewan when the month of June is far advanced, and after all the other summer birds have arrived and settled in their leafy arbours. Though gregarious in more southern countries, where they fly and feed in flocks, towards their northern limits seldom more than a pair are seen together. They feed on carrion, which they discover at a great distance, it is now said, by the sense of sight alone. They sometimes eat with such gluttonous voracity as to be unable to rise from the ground. They have been accused of attacking pigs, beginning the assault by picking out their eyes. But Mr Waterton, during his residence in Demerara, could not ascertain that they destroyed even living reptiles. He killed lizards and frogs and placed them in their way, but they took no notice of them till they began to emit a putrid effluvia. He differs from Mr Audubon in his ideas regarding the relative superiority in these birds of the organs of sight and smell. The one thinks the *eyes* have it, the other the *nose*. The turkey buzzard hatches her eggs in some swampy solitude, on a truncated hollow tree or excavated stump or log, laying them on the rotten wood. This species roosts at night on trees, but more seldom than the other kind in flocks. In winter they sometimes pass the night in numbers on the roofs of houses in the suburbs of the southern cities, probably induced to do so by the warmth which emanates from the chimneys. On fine clear days, even in the winter season, they amuse themselves by soaring majestically into the air, rising rapidly in large gyrations; and ascending beyond the thinnest fleecy clouds, they almost disappear from mortal view. In South America they will sometimes accompany the condor in his loftiest flights, rising, all fetid though they be, above the region of the purest Alps; and thus exhibiting an emblem of the mind of man, so often sunk in Epicurus' sty, yet for a time so raised by god-like genius, as not seldom to perceive "far off the crystal battlements of heaven."

The other species of this genus is the black vulture, or carrion-crow of the United States, *C. atratus*. It is rather less than the preceding, measuring about twenty-six inches in length, the general colour of the plumage dull black, with a dark cream-coloured spot on the primaries. It is more impatient of cold, and prevails chiefly about the larger maritime cities of South Carolina, Georgia, and Florida. They seem, from Mr Douglas's account, to proceed further north on the western side of the Rocky Mountains. Although they rise at times to a considerable elevation, their flight is less easy and graceful than that of the turkey buzzard. They are much more familiar, and in Charleston and Savannah may be seen walking the streets as demurely as domestic fowl. They sometimes become individually known; and a veteran with only one leg was observed to visit the shambles, and claim the bounty of a gentle butcher, for upwards of twenty years.

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[1] "The manner in which the Guachos catch these birds is to kill a horse and skin him; and they say that although not a condor is to be seen, the smell instantly attracts them. When I was at one of the mines in Chili, I idly mentioned to a person that I should like to have a condor: some days afterwards a Guacho arrived at Santiago from this person with three large ones. They had all been caught in this manner, and had been hung over a horse; two had died of galloping, but the other was alive. I gave the Guacho a dollar, who immediately left me to consider what I could do with three such enormous birds."

[2] *Rough Notes across the Pampas.*

Raptores.

Genus Neophron, Sav. *Cathartes*, Illig. *Percnopterus*, Cuv. Bill long slender, rounded, inflated at the curvature of the upper mandible, which is much hooked at the extremity. Nostrils median, oval, longitudinal, open. Cere covering two thirds of the bill. Face, cheeks, and throat naked, also a space extending down the middle of the neck. Tongue oblong, linear. Tail of fourteen feathers.

These birds are inhabitants of the ancient world. They are less powerful than the true vultures, and of smaller size, but are still more useful in their scavengerial functions, their love of putrid flesh, and of all impurities, being insatiable. The rachamach of Bruce, or gingi vulture of Sonnerat (*Neophron percnopterus*, Sav.), affords a characteristic example. See Plate CCCLXXXVIII. fig. 4. It is equal in size to a raven, the throat and cheeks naked, the feathers of the head and back of the neck long, narrow, and pointed. The plumage of the male is white, except the quill-feathers, which are black; that of the female and young is brown. This species has been described under a great variety of names. It occurs in several parts of Europe, more especially in Spain, Italy, and the Island of Elba. It is likewise widely distributed over Africa, where it is known to the Hottentots by the name of hougoop. It was held in great respect by the ancient Egyptians, and is frequently represented on the monuments of that mysterious people. It is said to follow caravans through the desert, for the sake of devouring every dead or unclean thing. We may add, that it has occurred once or twice in England.

Genus Gypaetos, Storr. Bill strong, straight, curved at the point, and somewhat inflated at the curvature. Cere basal, covered by strong bristly feathers pointing forwards. Nostrils oblique, oval, concealed by bristles. Tongue thick, fleshy, bifid. Head feathered. A tuft of bristly or hair-like feathers beneath the bill. Tarsi short, thick, feathered. Tail-feathers twelve.

This genus contains only a single species, the celebrated lammer-geyer, or bearded vulture of the Alps (*G. barbatus*). See Plate CCCLXXXVIII. fig. 5. It is one of the largest, or at least the longest-winged, of all the European birds of prey, haunting the highest mountains, and preying on lambs, goats, chamois, marmots, &c. Its strength and prowess are probably exaggerated, for although its powers of wing are undoubtedly great, its legs and talons are proportionally more feeble than those of eagles and falcons. It is said not unfrequently to secure its alpine prey by descending upon it suddenly with rushing wing, and driving it over a precipice, devouring the shattered limbs at leisure. It builds among inaccessible precipices, and lays two eggs. It is now one of the rarest of the birds of Europe, though formerly not uncommon among the mountains of Tyrol, Switzerland, and Germany. The peasant sportsmen of the last century often killed them, and one, Andreas Durner by name, is quoted by M. Michahelles as having shot sixty-five with his own hand. Though a bird of rare occurrence, the bearded vulture is very extensively distributed. In Europe it haunts the steeps of the Pyrenean Mountains, and the central Alps from Piedmont to Dalmatia; it is described by MM. Larey and Savigny as occurring in Egypt, and by Bruce as an inhabitant of Abyssinia; it has been received both from Northern Africa and the Cape of Good Hope, by M. Temminck; in Asia it is known to cast its cloud-like shadow over the vast steppes of the Siberian deserts; while not many years have elapsed since Professor Jameson received it from the snow-capped ranges of the Himalaya Mountains.

The bird described by Bruce under the title of *Abou Duck'n*, or Father Long-Beard, is certainly identical with the lammer-geyer, although we have been sometimes puzzled to reconcile the comparatively feeble feet of the beautiful series submitted to our examination by Professor Jameson, with the meat-bearing prowess of the Abyssinian instance. On the loftiest summit of the mountain of Lamallon, while the traveller's servants were refreshing themselves after the fatigues of a toilsome ascent, and enjoying the pleasures of a delightful climate and a good dinner of goat's flesh, a lammer-geyer suddenly made his appearance among them. A great shout, or rather cry of distress, attracted the attention of Bruce, who, while walking towards the bird, saw it deliberately put its foot into a pan containing a huge piece of meat prepared for boiling. Finding the temperature, however, somewhat higher than it was accustomed to among the pure gushing springs of that rocky and romantic region, it suddenly withdrew, but immediately afterwards settled upon two large pieces which lay upon a wooden platter, and transfixing them with its talons, carried them off. It then disappeared over the edge of a "steep Tarpeian rock," down which criminals were sometimes thrown, and whose mangled remains may be supposed to have first induced the bird to select the spot as a place of sojourn. The traveller, in expectation of another visit, immediately prepared his arms, and it was not long before the gigantic creature re-appeared.

> As when a vulture on Imaus bred,
> Whose snowy ridge the roving Tartar bounds,
> Dislodging from a region scarce of prey,
> To gorge the flesh of lambs or yeanling kids
> On hills where flocks are fed, flies towards the springs
> Of Ganges or Hydaspes, Indian streams;
> But on his way lights on the barren plains
> Of Sericana, where Chineses drive
> With sails and wind their cany waggons light:—

So landed with far-stretched fanning pinions our lammer-geyer, within ten yards of his expected savoury mess, but also within an equal distance of Bruce's practised rifle, which instantly sent a ball through its ponderous body, and the magnificent bird sunk down upon the grass, with scarce a flutter of its outspread wings.

We may here close our brief notice of the first great family of the raptorial order, merely remarking farther, that the species last alluded to, though not so regarded by any of our systematic writers, appears to us to bear a great resemblance to the kites.

FAMILY II.—FALCONIDÆ.

This extensive family corresponds to the ancient unrestricted genus *Falco*, now greatly subdivided by modern naturalists, but not yet very satisfactorily arranged.[1] It contains a vast assemblage of eagles, hawks, buzzards, kites, &c., all characterized by a more or less curved bill, of which the upper mandible is strongly hooked; by obvious or open nostrils, pierced in an almost always naked cere; and by curved retractile pointed talons. The head is never bare of feathers, as in most of the preceding family, and the eye-brows are usually bony and projecting.

The geographical distribution of the Falconidæ, considered in their generality, is universal, one or more species being found in all known countries from Spitzbergen to

[1] The genus *Falco*, which in the days of Linnæus did not exceed thirty-two different kinds, amounts, in the last edition of Dr Latham's *Synopsis*, to 247. We have no doubt it now exceeds 300 species, even although many of Latham's names are reducible to the rank of synonyms.

Raptores.

New Holland, and several particular kinds having a very wide range, not only longitudinally across the whole temperate and northern parts of Europe, Asia, Africa, and America, but latitudinally through almost every clime. Most of them are, to a certain extent, migratory in their habits, although their movements are by no means so regularly periodical as are those of more laborious wing. In fact, the birds of this family, surpassing all others both in the duration and rapidity of their flight, are scarcely amenable to those natural laws which, in so many instances, appear to regulate or restrict the location of other tribes; and hence we find, that if a mural precipice, an insulated crag, the mouldering wall of a ruined castle, or the tortuous branch of some ancient and umbrageous forest tree, has been successfully sought for in spring as a secure retreat for the purposes of nidification and the rearing of their young, the other seasons of the year are usually spent in a life of wandering rapine. When we consider the facts which have been recorded of the flight both of hawks and pigeons, the migratory movements of birds in general become much less a subject of wonder (excepting always the beautiful instinct by which they are directed), than they would at first appear. It is well known that a falcon belonging to Henry II. of France, which had been carried to Fontainebleau, made its escape, and was retaken *next day* in the island of Malta, where it was recognised by the rings on its legs. According to Colonel Montagu, it must have flown with a velocity equal to fifty-seven miles an hour, supposing it to have been on wing the whole time. "But as such birds never fly by night, and allowing the day to have been at the longest, or containing eighteen hours of light, this would make seventy-five miles an hour. It is probable, however, that it neither had so many hours of light in the twenty-four to perform the journey, nor that it was retaken the moment of its arrival; so that we may fairly conclude that much less time was occupied in performing that distant flight." Another falcon having been sent from the Canary Islands to the Duke of Lermos, then in Andalusia, was found in Teneriffe *sixteen hours* after it had taken its flight from Spain. In regard to this instance the calculation is more simple, and less likely to prove erroneous, because, supposing the bird to have followed anything like a direct course, its flight from the coast of Andalusia to its native island would lie throughout over the waters of the ocean, and must therefore have been *continuous*. Now the distance being not less than 752 miles, that space divided by sixteen, the number of hours employed would give an average of forty-seven miles an hour for the whole course. At this rate, if a falcon were to leave the rock of Gibraltar on a Monday morning, it might enjoy eight hours repose, and yet reach Edinburgh Castle in the course of Tuesday forenoon. Pigeons have been shot in the far-inland forests of America with their stomachs full of fresh rice, which, to have resisted the digestive process, must have been swallowed *not many hours* preceding, but could not have heen obtained within *eight hundred miles* of the place where they were killed.[1] It thus appears probable, that the most extended migratory movement which any species is required to perform, may in the greater number of cases be accomplished in a couple of days,—more frequently in the course of a few hours.

The numerous species by which this great family is constituted, though rarely adorned by those brilliant colours which characterize so many of the gentler tribes, are perhaps of all the feathered race the most remarkable for beauty of form and elegance of proportion. Their eyes are usually large and lustrous; their limbs, even when light, very strong and muscular, and armed with formidable claws with which they *pounce* their prey. Their general aspect (especially that of the true falcons), when compared with other birds, is well expressed by the word *noble;* and a single glance suffices to show that a combination of fierceness, energy, and courage, must form their predominating character. Like most other animals, however, whether human or brute, they are by no means insensible to kindness; and their instinctive sagacity, when directed by the skill and perseverance of man, has for ages been rendered subservient to his amusement in the sports of the field. But the princely art of falconry, whether from the progress of agriculture, the consequent minuter subdivision of land, and the increase of inconvenient barriers by the fencing of enclosed grounds,—or the tastes of men of rank and fortune having followed in another direction, has now almost entirely fallen into disuse. The species most generally trained for the purpose in this country appears to have been the peregrine falcon, but many other kinds are used in eastern regions; and even ponderous eagles are sometimes made subservient to the human will. Few things indeed more strongly illustrate the subduing influence of reason over instinct, than that a coarse illiterate groom, by tossing up a shapeless lure, should thus entice a proud rejoicing falcon from his airy height, and render him so submissively obedient as to forsake his soaring flight, and all his bright survey of field and river, and close contentedly his yet unwearied wings, to perch for hours upon a brawny arm, his lustrous eye encapped in velvet hood, and limbs "by jessies bound."

We must be very brief in our indications of the minor groups; and of several subgenera, as they are called, we can do nothing more than give the names. We do not here adopt the division of noble and ignoble birds of prey, which we deem a distinction without a difference, seeing that some of the long-winged hawks are difficult to train, while several of the short-winged kinds are made with ease submissive to the human race.

The genus DAPTRIUS of Vieillot (*Caracara*, Cuv.) is formed by the *Falco aterrimus* of Temm. (*Pl. Col.* 37 and 342). The cheeks and front of the throat are bare of feathers. The cere is haired. The adult plumage of the species named is black, with a white band spotted with black at the base of the tail; the bare portion of the face is flesh-coloured, the cere and legs yellow, the bill lead-coloured. The total length is about fifteen inches. It occurs in Guiana and Brazil. Its habits are unknown.

The genus IBYCTER of the same author (*Caracara*, Cuv.) has the cere smooth, and the upper part of the neck, as well as the cheeks, bare of feathers. The stomach is also bare and prominent. The tarsi are short, strong, and reticulated. We believe there is only a single species of this genus also, the *Ib. leucogaster* of Vieillot (*Gal.* pl. 6), or *Falco formosus* of Latham. Its bill is feeble, and but slightly hooked, and its habits offer a corresponding nonconformity with the usual manners of the raptorial order. It is of a mild and peaceable nature, living, it is said, chiefly on fruits and seeds, with the addition of a few insects, such as ants and locusts. It builds on trees, and utters from time to time a harsh discordant cry. It inhabits Guiana and Brazil, and, exhibiting some of the habits of the toucans, is called by the negroes the *capitaine des gros becs*.

The genus CARACARA, Cuv. (*Polyborus*, Vieil.), has the face only partially naked. The *C. Braziliensis* (Plate CCCLXXXVIII. fig. 6) is extremely common in Paraguay.

[1] Geese are also known to have been shot in Newfoundland with their crops full of maize, a species of corn which does not grow but at an immense distance from that island.

Raptores.

It lives in pairs, flies rapidly, and preys on birds and small quadrupeds, as well as on insects and reptiles. The female is said to build upon the ground when in the pampas, and on trees when located in wooded countries. This accommodating habit is known to prevail among many other birds.

The three preceding genera, which some regard as forming the *tribe of Caracaras*, are all native to the new world, and may be said to form a link with the vultures, both in regard to the bareness of the face, and their alleged tendency to prey on carrion.

We now proceed to the *tribe of eagles*, of which the bill is very robust, comparatively straight at its basal and middle portion, and suddenly curved at the extremity. It includes the species most celebrated for their strength and courage. Their strong limbs, curved talons, and broad expansive wings, enable them to carry off well-grown lambs, and other bulky prey. They are therefore dreaded by shepherds and such pastoral people, as robbers of the first rank, and a high premium is placed upon their heads accordingly.

In the genus Aquila properly so called, the bill is shorter than the head, straight, curved at the tip, the edge of the upper mandible with a slight festoon; the nostrils are oblong and oblique; the cere haired; the tarsi short, and covered with feathers. The well-known golden eagle (*A. chrysætos*) affords a characteristic example. This fine British species is widely spread over Europe and America. In our own country it builds on the ledges of mountain precipices—on the Continent its nest is frequently found in forests; for example, in that of Fontainebleau. It is common in the northern and central parts of Europe, but rarer in the south. It is, however well known in Italy. We have seen it sailing over the deep basin of the vale of D'Uomo d'Ossola, and high above the highest snowy peaks which glitter around the majestic passes of the Simplon. In America it breeds among the subalpine districts which skirt the Rocky Mountains, being seldom seen farther eastward. It is regarded by the aborigines as an emblem of strength and courage, and the Indian warrior as well as the highland chieftain glories in his eagle plume. These birds sometimes soar to a vast height, but they seem to do so rather as a kind of sporting exercise, than with a view to search for prey. When employed in hunting, they keep far nearer the earth, sweeping up the valleys, and skirting the sides of heath-covered mountains. The golden eagle is becoming rarer in Scotland every year. Many ancient eyries are pointed out to travellers by gray-haired shepherds, where the bird itself is now no longer known, and in no lengthened period we may expect its extirpation. Several other kinds of feather-footed eagles are known to naturalists, such as the *Aquila imperialis*, a common Egyptian species, not unfrequent in the eastern countries of Europe,—and the *Aquila Bonelli*, a recent acquisition, native to the mountains of Sardinia, and no doubt inhabiting other alpine lands. *Aquila fucosus* is a New Holland species, very common near Port Jackson, and remarkable for its fine wedge-shaped tail.

In the genus Haliætus, or sea-eagle, the bill is nearly as long as the head, and the tarsi are bare of feathers, except at the top. Their habits resemble those of the eagles proper, but they prey more on fish, and will feed more readily on tainted flesh. Species occur in Europe, Asia, Africa, America, and Australia. Our own white-tailed eagle (*H. albicilla*, Plate CCCLXXXVIII. fig. 8) affords a good example. "On observing a person walking near their nests," says Mr Macgillivray, "they fly around him at a respectful distance, sailing with outstretched wings, occasionally uttering a savage scream of anger, and allowing their legs to dangle, with outspread talons, as if to intimidate him. I have observed them thus occupied, when on the edge of a precipice five hundred feet high, with a very steep slope above me, bounded by rocks, and from which I could not have made my escape had the birds been resolute. Although on such occasions they are in general extremely cautious, notwithstanding their manifest anxiety for the safety of their young, yet I once saw an eagle come within an hundred yards, when it was brought down with buckshot by a friend whom I had accompanied to the place."[1] The same writer observes, that he has never heard of the sea-eagle attacking those employed in robbing its nest; but that he has been credibly informed of its having attempted to molest individuals whom it chanced to find among its native crags, in perilous places. In the Hebrides it is itself frequently assailed by the skua-gull; and we have ourselves more than once seen it attacked by the raven.

In our present group are many other species, such as the beautiful *Haliætus leucogaster* of New Holland, and the bald or white-headed eagle of America, *H. leucocephalus*. The latter is often seen sailing through and around the gigantic column of spray which rises from that "hell of waters," the cataract of Niagara. Though a bird of powerful wing, he seems to have fallen somehow into lazy habits, or at least prefers the produce of others' labours to his own. "Elevated," says Wilson, "on the high, dead limb of some gigantic tree, that commands a view of the neighbouring shore and ocean, he seems calmly to contemplate the motions of the various feathered tribes that pursue their busy avocations below,—the snow-white gulls slowly winnowing the air,—the busy tringæ coursing along the sands,—trains of ducks streaming over the surface,—silent and watchful cranes intent and wading,—clamorous crows,—and all the winged multitudes that subsist by the bounty of this vast liquid magazine of nature. High over all these hovers one whose action instantly arrests his whole attention. By his wide curvature of wing, and sudden suspension in air, he knows him to be the fish-hawk, settling over some devoted victim of the deep. His eye kindles at the sight, and balancing himself with half-opened wings upon the branch, he watches the result. Down rapid as an arrow from heaven descends the object of his attention, the roar of its wings reaching the ear as it disappears in the deep, making the surges foam around. At this moment the eager looks of the eagle are all ardour; and levelling his neck for flight, he sees the fish-hawk once more emerge, struggling with his prey, and mounting in the air with screams of exultation. These are the signals for our hero, who, launching into the air, instantly gives chase, and soon gains on the fish-hawk; each exerts his utmost to mount above the other, displaying in these rencontres the most elegant and sublime aërial evolutions. The unencumbered eagle rapidly advances, and is just on the point of reaching his opponent, when with a sudden scream, probably of despair and honest execration, the latter drops his fish:—the eagle poising himself for a moment, as if to take a more certain aim, descends like a whirlwind, snatches it in its grasp ere it reaches the water, and bears his ill-gotten booty silently away into the woods."[2] When forced to hunt for themselves, they often attack young pigs, lambs, and sickly sheep.

In the genus Pandion the bill is much shorter than the head; the tarsi are short and naked, covered all round with

[1] *Rapacious Birds of Britain*, p. 60.

[2] *American Ornithology*, vol. i. p. 23. We quote Professor Jameson's *systematic edition*, in four small volumes (Constable's *Miscellany*, 1831). The student of American Ornithology will find some valuable notes by Sir William Jardine, in another Edinburgh edition, in three vols. large 8vo, 1832.

imbricated scales; the claws are large and rounded on the under surface, the outer toe very versatile; and the second feather of the wing the longest. Our British osprey, or small fishing eagle, is the *Pandion haliætus*. It breeds in the vicinity of many of our northern sea-lochs, often on the chimney-top of ruined castles by the shore. It destroys a vast quantity of fish, which it secures by thrusting its talons through their backs during a sudden momentary plunge beneath the waves. It is remarkably abundant in North America; and Wilson observes that it permits the purple grakles to build their nests amid the interstices of the sticks of which it has framed its own. He adds, that it never picks up any fish which it may chance to drop either on land or water. We know not if this trait applies to those of the "old country." We once saw an osprey drop a large sea-trout, which it certainly did not attempt to recover; but then there happened at the same time to be an excellent shot, with a double barrel, within a rather dangerous distance of the same. The osprey occurs in New Holland, and is elsewhere very widely spread.

The genus CIRCÆTUS of Vieillot is in a manner intermediate between the fishing eagles, the ospreys, and the buzzards. We may mention as an example the bird called *jean-le-blanc* by the French (*F. Gallicus*, Gmelin), a common continental species.

In HARPYIA, Cuv. the bill is very strong, and compressed, the upper mandible dilated on the margins, and much hooked. The head is crested, the tarsi thick, the wings rather short. The harpies are large birds of prey, which dwell chiefly in the forests of Guiana, making their nests on trees, and committing great depredations. The largest is the *H. destructor* of Daudin (Plate CCCLXXXVIII. fig. 7), said to be capable of cleaving a man's skull by a single blow of its beak. We doubt if any one ever tried. However, it carries off young fawns, and sloths of a year old. It is a rare bird, lately imported to the Zoological Gardens of London, and well exemplified by the specimen in the Edinburgh Museum.

In the genus MORPHNUS of Cuv. (*Spizætus*, Vieillot), the wings are shorter than the tail, the tarsi are lengthened (in some feathered), and the toes feeble. The species are extremely beautiful, and richly varied in their markings. They are chiefly found in South America. We have figured as an example (see Plate CCCLXXXVIII. fig. 9) the *Morphnus cristatus* (*F. Guianensis*, Daud.), which strongly resembles the great harpy just mentioned in its general aspect, but is at once distinguished by its smaller size and longer tarsi. We may mention as an instance of those with plumed tarsi, the *Falco cristatellus* of Temm. *Pl. Col.* 282, which is a native of India and Ceylon.

In CYMINDIS, Cuv. and Temm. the tip of the upper mandible forms a lengthened curve, with a very acute point. The nostrils are obliquely cleft, almost closed; the cere narrow. The tarsi are very short, and reticulated; the wings rather long. The species are South American, and we know of nothing remarkable in their habits. See *Cymindis uncinatus*, Illiger, *Pl. Col.* 103. The extremely hook-billed species (*C. hamatus*, *Pl. Col.* 61) now forms the genus ROSTRHAMUS. Its nostrils are rounded, the space before the eye is bare, and the tarsi are scutellated. Its habits are unknown.

Naturalists differ greatly in their distribution of the preceding genera. Mr Swainson thinks *Circætus* is a subgeneric form of *Gypogeranus*, and he places *Cymindis* with the Caracaras, and certain other groups, in his sub-family *Cymindinæ* or kites, and locates *Morphnus* (*Spizætus*, Vieil.) with the buzzards.

We now proceed to a *third tribe*, consisting chiefly of the sparrow-hawks and goshawks. The bill is curved almost from the base, convex, the upper mandible dilated on the sides, the lower short and obtuse. The nostrils are nearly oval; the tarsi rather long and slender; the claws broad and sharp. The wings have the fourth feather the most extended, and are shorter than the tail. The species are numerous, and occur in all parts of the globe. The larger, which are also proportionally the more robust, with thicker tarsi and shorter wings, have by many Ornithologists been considered as constituting a separate genus, to which the name of ASTUR is applied. That rare British bird the goshawk (*Astur palumbarius*) may be named as a good example, while the smaller and more slender kinds included in the genus NISUS are represented by our sparrow-hawk (*N. communis*, the *Falco nisus* of Linn.). The transition from one to the other is however very gradual, and some deem their separation unwarrantable. Even the two British species, though usually regarded as the types of their respective sections, do not differ so much as to render the propriety of their separation very apparent, even were no other species known. They are all extremely active, as daring as the true falcons, and prey exclusively on living objects, which they seize with admirable dexterity. Their flight is generally low, and as they pass over the fields or woods, they dart upon their prey, whether it be in the air, among branches, or couched upon the ground.[1] The goshawk, though a short-winged species, was formerly held in great estimation for the purposes of falconry. It is one of the most generally diffused of all the accipitrine birds, but is now very rare in Britain. A beautiful white species (*Astur albus*) is found in New Holland. Of the sparrow-hawks we shall allude merely to the *Nisus musicus* of Africa, commonly called the chanting falcon. It is the only raptorial bird in any way gifted with the powers of song; but we must not suppose that its notes at all resemble the harmonious tones of the nightingale, or those of even our less accomplished songsters. Its voice is merely a little clearer than usual, although it seems impressed with a high idea of its own powers, and will sit for half a day perched upon the summit of a tall tree, uttering its incessant cry.

A *fourth tribe* contains the *kites*, which are likewise subdivided into several minor groups, all agreeing in their comparatively feeble bills and feet, their short tarsi, and long extended wings. The tail is forked. They are gifted with great powers of flight, but are neither strong nor courageous, seldom pounce on heavy game, sometimes contrive to prey on fish, and have never the slightest objection to chickens.

In the genus MILVUS of Cuv. is included our common kite (*M. regalis*, Vieil.; *Falco milvus*, Linn.). The tarsi are scutellated in front, and tolerably strong. This beautiful bird is rare in many districts of Scotland, and is scarcely ever seen in the Lothians. We have received it from Argyllshire, but do not think it occurs in the Western Isles. We have often, in the North of England, admired its wheeling flight, circling through the air with no perceptible motion of its long expanded wings, and sailing over that enchanting land of lakes and mountains, with such majestic sweeps as if it were itself "sole king of rocky Cumberland." The kite is distributed over all Europe, but is unknown in America. Other species of the genus occur in Asia, Africa, and New Holland.

In the genus ELANUS of Savigny the tarsi are very short, reticulated, and half clothed with feathers. The wings are long, the tail but slightly forked. It contains *F. dispar* and *melanopterus*, two species which some regard as one and the same. They feed on small birds, insects, and reptiles, and occasionally devour dead animals.

[1] *Rapacious Birds*, p. 231.

Raptores. If identical, the species must exist in America, Africa (occasionally in Europe), and the East Indies. The swallow-tailed kite (*M. furcatus*) forms the genus NAUCLERUS of Vigors. See Plate CCCLXXXIX. fig. 1. The form is slender, the tail very long and greatly forked. The species just named is white, with back, wings, and tail black, glossed with green and purple. It inhabits America, at least as far south as Buenos Ayres, and also passes the summer and breeds in the warmer parts of the United States. Tempted by the abundance of the fruitful valley of the Mississippi, a few are seen to wander as far as the Falls of St Antony, in the forty-fourth degree. Audubon states, that in calm warm weather they soar to an immense height, pursuing the large insects (probably libellulæ) called musquito hawks, using their tails with an elegance peculiar to themselves, and performing the most singular evolutions. The Mississippi kite (*F. plumbeus*, Latham) constitutes the genus ICTINIA of the modern systems. It is of a blackish ash colour, the head and under parts of a much paler ashy hue. Wilson frequently observed this hawk in the course of his perambulations, sailing about in easy circles, at a considerable height in the air, and generally in company with Turkey buzzards, with whose mode of flight its own exactly corresponds. It is not easy to say why two birds, whose food and manners are in other respects so different, should so frequently associate in their airy gambols. Though the Mississippi kite feeds chiefly on reptiles and insects, it is a bold and energetic bird. The specimen obtained by Wilson, though wounded, and precipitated from a stunning height, exhibited great strength, and a most unconquerable spirit. He no sooner approached to pick it up, than the bird immediately gave battle, striking rapidly with its claws, wheeling round and round as it lay, "partly on his rump," and defend ng itself with vigilance and dexterity. Notwithstanding all the aggressor's caution, it struck its hind claw into his hand, with such force as to penetrate into the bone. "Anxious to preserve his life, I endeavoured gently to disengage it; but this made him only contract it the more powerfully, causing such pain that I had no other alternative but that of cutting the sinew of his heel with my penknife." The whole time he lived with Wilson he seemed to watch his every movement, erecting the feathers of his head, eyeing him with fierceness, and no doubt regarding him (and with some show of justice) as the greater savage of the two.

In a *fifth tribe* we may place the honey-hawks, buzzards, and harriers, small groups connected, in a variety of ways, by the usual interlacements, with several of the preceding tribes. The buzzards, for example, both in form and plumage, resemble small eagles, though their bills are more curved from the base;[1] the harriers in some measure connect the buzzards with the accipitrine hawks (gen. *Nisus* and *Astur*); while the honey-hawks (*Pernis*) unite the buzzards to the kites. The natural affinities of groups are in truth so multiplied and complex, that we need scarcely wonder that even those who have most devoted themselves to explore such Cretan labyrinths, should have often failed in their supposed elucidation:—so much the worse for those who have never found the thread.

In the genus PERNIS, Cuv. the lore, or space between the bill and eye, is closely covered by small, compact, rounded feathers, the nostrils are narrow, and the tarsi short, stout, and reticulated. The British bee-hawk (*P. apivorus*), or honey-buzzard as it is usually called, though it cares less for the honey than for those that make it, is of this genus. We have no other indigenous, or indeed European species; but a beautiful crested kind (*P. cristata*, Cuv.), Plate CCCLXXXIX. fig. 2, occurs in Java and the East Indies. *P. Ellioti* is also native to the latter country.

In the genus BUTEO, Bechstein, the cutting margin of the upper mandible is more flexuous or tooth-like, the gape wider, and the space between the eye and the cere is covered by the same setaceous plumage which usually prevails in that part, the nostrils are rounded, and the tarsi scutellated in front. The buzzards are a numerous genus, distributed over most parts of the world. We have only two British species, the common buzzard (*Buteo vulgaris*), and the rough-legged kind (*B. lagopus*). The latter is a rare or rather accidental visitor, its proper districts being the northern parts of Europe and America. We think buzzards are most abundant in wooded countries. They fly more sluggishly than hawks, and generally rather low, but at times they ascend to a great height, sweeping round in easy circles, and uttering a frequent shrilly cry.

In the genus CIRCUS the bill is slender and compressed, the cere large, the cheeks encircled by a kind of recurved ruff, and the tarsi long, slender, and scutellated before and behind. We have three British species, the moor harrier (*C. æruginosus*), the common ringtail or hen-harrier (*C. cyaneus*, male,—*C. pygargus*, female), and Montagu's harrier (*C. cineraceus*). All these birds roost and breed upon the ground, fly low, and frequent mountainous or marshy places. They prey upon whatever small-sized creatures they can master, whether beast, bird, reptile, or insect. The hen-harrier is supposed to occur in almost all parts of the world, but the identity of the American and European specimens has not been definitely determined. We have figured a foreign species as an example in Plate CCCLXXXIX. fig. 5. It is the *Circus palustris* of Temminck (*C. superciliosus* of some other authors), and a native of Brazil.

We now arrive at the falcons properly so called, or those which have been sometimes distinguished by the appellation of *noble birds of prey*, probably on account of certain members of the group, such as the peregrine and jer-falcon, being held in high esteem as accessaries in the sports of the field. We cannot say that we have been led to our present arrangement by an impression that it is more natural than any other, for we have already left the point which would have conducted us more insensibly into the ensuing nocturnal group of owls; but we do not think it is liable to more grave objections than are many others. Indeed the circular or recurrent nature of the actual affinities of natural groups renders their true exposition, so far as any consecutive system is concerned, impossible; for, instead of advancing, we must necessarily terminate where we began, and therefore either retrace a portion of our circle, or break or bend it, before we can proceed to another. Without, therefore, desiring the reader to suppose that the harriers in any special way conduct him to the falcons, we shall give a brief notice of the latter.

The falcons are chiefly distinguished by the strong, tooth-like notching of the bill, which in the preceding groups is either entirely absent, or shows itself only in the form of a more or less distinct festoon.[2] The first quill-feather is always long, the second longer than the third and fourth, so that the wing acquires a sharp or pointed form, instead of the rounded outline of the so-called ignoble tribes; and the points of the wings, when closed, usually attain to the end of the tail.

[1] Mr Macgillivray mentions, that the digestive organs of the common buzzard so greatly resemble those of the golden eagle, that a figure of the one might serve for that of the other.

[2] It is, we believe, in vain that naturalists attempt exceptionless precision in their generalities; for, in this very group, the jer-falcon, in one sense the *noblest* of all, frequently wants the tooth, and exhibits a bill festooned like the eagle's.

Raptores.

In the restricted genus Falco, then, the bill is short, but strong, conical, curved from the base, sharply hooked at the extremity, and almost always toothed as well as pointed; the nostrils are rounded, the cere bare, or merely encroached upon by the bristly feathers of the lore. The tarsi are rather short and strong, and covered with scales of somewhat variable form, but usually rounded or angular. The wings are long and pointed. We have four well-known British species, the peregrine falcon (*F. peregrinus*), the hobby (*F. subbuteo*), the merlin (*F. æsalon*), and the kestril (*F. tinnunculus*). Besides these, we may name the jer-falcon (*F. islandicus*, Plate CCCLXXXIX. fig. 4) as an occasional, and the orange-legged hobby (*F. vespertinus*) as an accidental visitor. The jer-falcon, in spite of its alleged want of teeth, is one of the boldest and most powerful of the class. This fine species seems now confined almost entirely to the most northern parts of Europe and America. It is well known in Iceland and Greenland, and was often seen by Dr Richardson during his journeys over the "barren grounds" of North America, where it preys habitually on ptarmigan, not, however, despising plovers, ducks, and geese. "In the middle of June," he observes, "a pair of these birds attacked me as I was climbing in the vicinity of their nest, which was built on a lofty precipice on the borders of Point Lake, in latitude 65½°. They flew in circles, uttering loud and harsh screams, and alternately stooping with such velocity that their motion through the air produced a loud rushing noise; they struck their claws within an inch or two of my head. I endeavoured, by keeping the barrel of my gun close to my cheek, and suddenly elevating its muzzle when they were in the act of striking, to ascertain whether they had the power of instantaneously changing the direction of their rapid course, and found that they invariably rose above the obstacle with the quickness of thought, showing equal acuteness of vision and power of motion. Although their flight was much more rapid, they bore considerable resemblance to the snowy owl."[1] Upon the whole, we think that Great Britain and Ireland are just as well quit of such a fierce intruder. The Doctor adds, that when the jer-falcon pounces down upon a flock of ptarmigan, the latter endeavour to save themselves by diving instantly into the loose snow, and making their way beneath it to a considerable distance.

A few species, in which the toothing of the upper mandible is double, form the genus Bidens of Spix, synonymous, we presume, with *Harpagus* of Vigors. Such are *F. bidentatus*, Lath., *F. diodon*, Temm. *Pl. Col.* 198. In Ierax of Vigors, the upper mandible seems as strongly and sharply bidentated as in the preceding, but the under one is simply notched, as in the true falcons, and the second quill-feather of the wing is the longest. This genus includes the beautiful little finch-falcon of Bengal, *F. cærulescens*, the smallest of the hawk tribe. An elegant crested kind from Pondicherry serves as a type to the genus Lophotes.

We shall conclude this section by a brief indication of that remarkable bird, the secretary, or serpent-eater of Southern Africa—the *Gypogeranus serpentarius* of Illiger (see Plate CCCLXXXIX. fig. 9). Its affinities have been in no way satisfactorily illustrated, and each author has hitherto placed it according to his own fancy. Baron Cuvier locates it between the buzzards and the owls; M. Lesson makes it a "gallinaceous accipiter," in strange company with the horned screamer (*Palamedea cristata*) of Brazil; while Mr Swainson is now satisfied that it is no other than "the rasorial type of the aquiline circle." Be this as it may, it has a strong, well-curved bill, a crested head, a lengthened neck, and long, slender, crane-like legs. It is the only one of its genus, and has been designated by a variety of names. Some call it the messenger, because it runs with great rapidity, which few actual messengers ever do; others name it the secretary, because it has a pen-like plume behind its ear, where a secretary's pen should never be; while its frequent title of serpent-eater is probably better earned, by its useful habit of devouring those dangerous reptiles. Its diet, however, seems to be of a rather miscellaneous nature, as Le Vaillant found in the stomach of a single specimen twenty-one young tortoises, three snakes, and eleven lizards, besides which there was a large ball in the stomach, formed entirely of the scales of tortoises, the vertebræ of snakes and lizards, the legs of locusts, and the wing-cases of coleopterous insects. "In his habits," says Mr Bennet, "he partly resembles both the eagle and the vulture, but differs from them most completely in the nature of his prey, and in his mode of attacking it. Like the former, he always prefers live flesh to carrion; but the food to which he is most particularly attached consists of snakes and other reptiles, for the destruction of which he is admirably fitted by his organization. The length of his legs not only enables him to pursue these creatures over the sandy deserts which he inhabits, with a speed proportioned to their own, but also places his more vulnerable parts in some measure above the risk of their venomous bite; and the imperfect character of his talons, when compared with those of other rapacious birds, is in complete accordance with the fact, that his feet are destined rather to inflict powerful blows than to seize and carry off his prey. When he falls upon a serpent, he first attacks it with the bony prominences of his wings, with one of which he belabours it, while he guards his body by the expansion of the other. He then seizes it by the tail, and mounts with it to a considerable height in the air, from which he drops it to the earth, and repeats this process until the reptile is either killed or wearied out; when he breaks open its skull by means of his beak, and tears it in pieces with the assistance of his claws, or, if not too large, swallows it entire. Like the eagles, these birds live in pairs, and not in flocks; they build their aiery, if so it may be termed, on the loftiest trees, or, where these are wanting, in the most bushy and tufted thickets. They run with extreme swiftness, trusting, when pursued, rather to their legs than to their wings; and as they are generally met with in the open country, it is with difficulty that they can be approached sufficiently near for the sportsman to obtain a shot at them. They are natives of the south of Africa, and appear to be tolerably numerous in the neighbourhood of the Cape, where, it is said, they have been tamed to such a degree as to render them useful inmates of the poultry-yard, in which they not only destroy the snakes and rats which are too apt to intrude upon those precincts, but even contribute to the maintenance of peace among its more authentic inhabitants, by interposing in their quarrels, and separating the furious combatants who disturb it by their brawls."[2]

Sect. II.—Nocturnal Birds of Prey.

The great raptorial division called owls are usually distinguished by the comparative largeness of their heads, the anterior portion of which is surrounded by a peculiar circle of feathers forming a facial collar, to which they owe the most marked and peculiar feature of their physiognomy. The bill is curved almost from the base, where it is greatly enveloped by setaceous feathers, which fre-

[1] *Fauna Boreali-Americana*, part ii. p. 28.

[2] *Tower Menagerie*, p. 211.

Raptores. quently cover or conceal the cere and nostrils. The eyes are large, and so placed that vision is directed rather forwards than laterally, and are furnished with a nictitating membrane. The tarsi, and even the toes, are closely covered by short downy or hairy feathers. The outer toe is versatile; the claws extremely sharp. The plumage is remarkable for its great softness. The concha of the ear is for the most part very large; and from this we may infer that the sense of hearing is acute.

The greater proportion of the species hunt by night, or during the sweet but sombre hours of twilight. Their flight is light, buoyant, noiseless, and performed by slow but regular flapping of the wings. Their food, like that of most birds of prey, is various; but we believe they prefer mice and similar small quadrupeds, probably because the habits of these minute creatures are, like their own, nocturnal. Owls are solitary, seldom more than a pair being found together, although the woodcock owl (*Otus brachyotus*) is found during autumn in small conjoined family flocks of ten or twelve together; and the Arkansa owl of America is likewise in a manner gregarious. "There is something," says Wilson, "in the character of the owl so recluse, solitary, and mysterious, something so discordant in the tones of its voice, heard only amid the silence and the gloom of night, and in the most lonely and sequestered situations, as to have strongly impressed the minds of mankind in general with sensations of awe and abhorrence of the whole tribe. The poets have indulged freely in this general prejudice; and in their descriptions and delineations of midnight storms, and gloomy scenes of nature, the owl is generally introduced to heighten the horror of the picture."

The systematic arrangement of these nocturnal birds of prey is as yet unsatisfactory. The following is a brief view of Baron Cuvier's system.

The genus OTUS has two well-marked aigrettes, or tufts of feathers, on the front of the head, capable of being depressed or raised at pleasure, and the conch of the ear extends semicircularly from the beak almost to the top of the head, and is furnished in front with a membranous opercle. Two British species may be here placed, the long-eared or horned owl commonly so called (*Strix otus*), and the short-eared owl (*Strix brachyotus*). The genus ULULA consists of species resembling the preceding in the bill and auditory opening, but not possessed of aigrettes. Such is the great northern species (*S. Laponica*, Gm.). The genus STRIX properly so called has also large ear-openings, and wants the aigrettes, but is distinguished by the bill being comparatively straight at the base, and curved towards the extremity. The facial disk is strongly marked, the tarsi are feathered, and the toes are haired. Example, *Strix flammea*, our barn or white owl. In the genus SYRNIUM, the facial disk is formed of decomposed or unwoven feathers, the collar is also large, and the aigrettes wanting, but the toes are feathered. See Plate CCCLXXXIX. fig. 6. The brown or wood owl of Britain (*S. aluco* and *stridula*, Linn.) is placed here. The genus BUBO has the facial disk less marked, the aigrettes conspicuous, and the toes feathered. The great eagle owl of Europe (*B. maximus*, *S. bubo*, Linn.) affords a good example. It inhabits the larger forests of Russia, Hungary, Germany, and Switzerland, becoming very rare in France, disappearing altogether in Holland, and visiting Great Britain as it were by chance. Here also may be placed the great horned owl of America, *S. Virginiana* (Plate CCCLXXXIX. fig. 8), which occurs in almost every quarter of the United States, and spreads into the far fur-countries of the north, wherever there is timber of sufficient size to serve the purposes of nidification. His favourite residence, however, according to Wilson, is the dark solitudes of deep swamps, covered by a growth of gigantic timber, from whence, so soon as evening darkens, and the human race retire to rest, he sends forth his unearthly hootings, startling the way-worn traveller by his forest fire, and "making night hideous." "Along the mountainous shores of the Ohio, and amidst the deep forests of Indiana, alone, and reposing in the woods, this ghostly watchman has frequently warned me of the approach of morning, and aroused me by his singular exclamations, sometimes sweeping down and around my fire, uttering a loud and sudden *waugh o! waugh o!* sufficient to have alarmed a whole garrison. He has other nocturnal solos, no less melodious, one of which very strikingly resembles the half-suppressed screams of a person suffocating or throttled, and cannot fail of being exceedingly entertaining to a lonely benighted traveller in the midst of an Indian wilderness."[1] The genus NOCTUA consists of species in which the tufts or aigrettes are wanting, the concha of the ear small, with an ordinary-sized opening. The facial disk is likewise small and incomplete. This gives the countenance a more hawk-like physiognomy; and in accordance with this expression, we find the habits of the species naturally more diurnal than those of many other owls. We here place the northern *Harfang*, or great snowy owl (*Strix nyctea*, Linn.), one of the most beautiful of the group, an occasional visitant of Great Britain, and not very unfrequent in the Orkney and Shetland Islands. It is a common inhabitant of the arctic regions of both the old and new world, from which it migrates on the approach of winter, but without passing to the southward of the colder portions of the temperate zone. It frequently hunts by day; and indeed if it did not so, what would become of it in those far northern countries where a "sleepless summer of long light" knows not for months the refreshing influence of nocturnal darkness? It preys not only on quadrupeds and birds, but frequently strikes its talons into fish, and bears them astonished from their moist abode into the leafy recesses of the forest. There are few things more out of place than a trout on the top a large tree. Its own flesh is said to be white and well flavoured; and when in good condition, is eaten both by the native Indians and the white residents in the fur-countries. Several of the smaller owls are included in the present genus, such as *Strix passerina*, Linn. In the genus SCOPS (Plate CCCLXXXIX. fig. 7) the toes are naked, and the head furnished with tufts; and in certain peculiar foreign species of considerable size, the tarsi (a very unusual character) are bare and reticulated. These have been formed of late into a genus called KETUPA. Example, *Strix Ketupa*, Horsfield, Temm. *Pl. Col.* 74.

One of the most curious of owls, in its habits, is the burrowing species of the new world—*Strix cunicularia* of Bonaparte. Its particular genus has not yet been determined. These birds inhabit the burrows of the marmot, and consequently dwell in open plains. They seem to enjoy even the broadest glare of the noon-day sun, and may be seen flying rapidly along in search of food or pleasure during the prevalence of the cheerful light of day. They manifest but little timidity, allow themselves to be approached sufficiently close for shooting, and though some or all may soar away, they settle down again at no great distance. If further disturbed, they either take a more lengthened flight, or descend into their subterranean dwellings, from whence they are dislodged with difficulty. When the young are only covered with down, they frequently ascend the entrance to enjoy the warmth of the mid-day sun; but as soon as they are approached, they quickly retire within their burrow. In North America the burrowing owl feeds

[1] *American Ornithology*, i. p. 101.

chiefly on insects—in the West Indies (if the species are identical), on rats and reptiles.

Order II.—INSESSORES or PERCHING BIRDS.[1]

This is the most numerous order of the class of birds, and, as Cuvier has observed, is distinguished chiefly by negative characters; for it embraces all those various groups which, sometimes possessing but little in common, are yet in themselves neither raptorial, scansorial, grallatorial, natatorial, nor gallinaceous. At the same time they exhibit a general resemblance to each other in structure, and present such gradual transitions from group to group, as to render definite subdivisions by no means easy.

They are said to possess not the violence of birds of prey,—meaning thereby our preceding accipitorial order. Yet a fly-catcher crushing the body of a slender-limbed and delicate gnat, a blackbird pertinaciously dragging a reluctant worm from its subterranean dwelling, or a sparrow with his bill as full of tortuous caterpillars as it can contain (to say nothing of the butcher-bird, which is said to impale his prey alive upon " the blooming spray"), is assuredly as raptorial or predaceous as need be well desired. Neither can the division of the smaller birds into granivorous and insectivorous be strictly maintained, though we doubt not that the strong, conical billed species eat most greedily of seeds and grain, while those of softer and more slender bill are chiefly avidous of insect life;—but all precise divisions, founded on the love of any special diet, must be received with reservation,—seeing that almost all passerine birds feed both themselves and young in spring and early summer with what may be correctly called animal food (that is, insects and worms), while in autumn and throughout the winter season they just as generally (and for the best of reasons) have recourse to all manner of seeds and grain. The tender-billed birds are certainly more dependent on insect food than the others, and it is consequently among them that we find the greater proportion of our migratory species; for as the increasing chillness of autumn depopulates the busy world of insect life, so our finest songsters (the familiar red-breast forming a delightful exception) take then their departure for other climes, not so much by reason of the immediate influence of cold upon themselves, as because they find their accustomed food becoming daily less abundant. Such of the insectivorous tribes as remain with us throughout the year assuredly combine the graminivorous diet with their more favourite food, just as the hard-billed species sustain themselves during spring and summer by the capture of insects. In tropical countries, where the seasons are less strongly or differently marked, and the death-like torpidity of our northern winters is unknown, this periodical change of food may probably either not obtain, or be less perceptible in its occurrence; but as we know that over a great part of the globe it is true, that for one portion of the year most insect-eating birds feed on seeds, and that for another portion of the year most seed-eating birds feed on insects, we may be permitted to doubt the propriety of rigorously dividing the great body of passerine species into insectivorous and granivorous sections. We admit that, either from the nature of things, or the feebleness of human language, the terms applied to the greater divisions of natural history ought not to be construed according to their strictest literal interpretation, as they are frequently of a conventional character, and have in some cases been substituted for numerical signs, as more easily held in remembrance; but it is nevertheless to be greatly desired, that those who are influential in the nomenclature of science should avoid bestowing appellations which convey an erroneous idea of the objects intended to be expressed.

The feet of the insessorial order are especially formed for perching, the hind toe springing from the same plane as the anterior ones,—a structure which gives them great power in grasping. Their legs or tarsi are always of moderate length, and the claws not strongly curved. The form of the bill is too various to be generalized; and the same may be said of the length of the wings, of which the comparative breadth generally bears relation to the habit of life of each particular tribe. The stomach is in the form of a muscular gizzard, generally preceded by a greater or less expansion in the shape of crop, and there are usually two very small cæca. The lower larynx is very complicated, especially among the various tribes of songsters. We must now rest satisfied with these brief and barren generalities. " The great order of Passeres or Insessores of authors," Mr Macgillivray observes, " is so heterogeneous in its composition, that all who have attempted to characterize it, whether in few or in many words, have utterly failed; for this plain reason, that its various groups are as unlike to each other as they are to the Raptores or Rasores, and that in fact the only common features which they exhibit are those of the general organization of birds. A hornbill and a humming-bird, a parrot and a wren, a kingfisher and a swallow, a starling and a toucan, not to mention others still more dissimilar, are surely as unlike each other as a hawk and a shrike, a pigeon and a plover, or a flamingo and a pelican."[2]

The first principal division of the passerine birds consists of those genera in which the external toe is united to the internal by not more than one or two of the joints, and contains the four great tribes of *Dentirostres*, *Fissirostres*, *Conirostres*, and *Tenuirostres*.

Tribe 1st.—Dentirostres.

Bill with a marginal notch towards the extremity of the upper mandible.

The dentirostral tribe is composed chiefly of insectivorous groups, and, according to the modern views, contains the following five families, viz. *Laniadæ*, *Merulidæ*, *Sylviadæ*, *Ampelidæ*, and *Muscicapidæ*. We do not think the general reader, with whose tastes the treatises in our Encyclopædia are for the most part made to conform, would be benefited by our entering into the complexities of these circular arrangements, or by an extended exposition of the innumerable minor groups of which the families are composed. We shall therefore here content ourselves by noticing the principal generic groups which form as it were the groundwork on which the more elaborate systems have been erected, and with which it is necessary to become familiar in their more general and comprehensive form, before their minuter subdivisions (to be elsewhere studied) can be understood. The genera are chiefly determined by the form of the bill, which is strong and compressed among the shrikes and thrushes, depressed in the fly-catchers, rounded and thickish in the tanagers, slender and pointed in the warblers,—but in each and all exhibiting different degrees of the typical character, or a tendency to transition, which admits of various systematic views.

Mr Swainson divides the Laniadæ or shrikes into five sub-families, viz. *Lanianæ*, or true shrikes; *Thamnophilinæ*, or bush-shrikes; *Dicrurinæ*, or drongo shrikes; *Ceblepyrinæ*, or caterpillar catchers; and *Tyranninæ*, or tyrant shrikes; and each of these contains a great variety of ge-

[1] Picæ and Passeres, Linn.

[2] *British Birds*, vol. i. p. 311.

Insessores. nera and subgenera. We shall here follow the outlines of Baron Cuvier's system, which we shall illustrate by occasional figures.[1]

In the genus Lanius, the bill is of moderate size, but strong, somewhat triangular at the base, and laterally compressed. In the European species (which we call butcher-birds) the upper mandible is somewhat arched. Three of these (*Lan. excubitor*, *colurio*, and *rufus*) are natives of England, but the first and last are very rare. The food of butcher-birds consists chiefly of insects, but they attack occasionally the smaller kinds of birds and quadrupeds. Their mode of flight is irregular, the tail being kept in constant agitation. The sexes differ from each other in their plumage, and the immature birds bear a resemblance to the adult females. In most of the species the moult is single, in others double, that is, certain parts of the plumage are changed twice a year. Our great cinereous shrike (*L. excubitor*) destroys its larger prey by strangulation, and transfixing it after death upon a thorn, tears it into smaller parts at leisure. This wise but somewhat savage instinct seems implanted in the bird to make amends for the comparative weakness of its feet and claws. "This singular process," says Mr Selby, "is used with all its food. I had the gratification of witnessing this operation of the shrike upon a hedge accentor (*A. modularis*) which it had just killed; and the skin of which, still attached to the thorn, is now in my possession. In this instance, after killing the bird, it hovered with the prey in its bill for a short time over the hedge, apparently occupied in selecting a thorn fit for its purpose. Upon disturbing it, and advancing to the spot, I found the accentor firmly fixed by the tendons of the wing at the selected twig. I have met with the remains of a mouse in the stomach of a shrike; and Montagu mentions one in which he found a shrew."[2]

We have figured, in illustration of the genus Lanius, the species called *fiscal* (*L. collaris*) by Vaillant. See Plate CCCXC. fig. 1. When this bird sees a locust, mantis, or small bird, it springs upon it, and immediately impales it on a thorn, with such dexterity, that the spine always passes through the head. It is a bold, vindictive, noisy, and even cruel bird, for it seems to kill many more victims than it actually requires for food. These are found transfixed on many a neighbouring bush and tree, the major part often so destroyed by dryness as to be totally unfit for food.

Some foreign species, in which the upper ridge of the bill is straight, and the point only curved, form the genus Thamnophilus of Vieillot. The Thamnophili inhabit chiefly the tropical regions of the new world, but some of the species have an extensive range, from Canada as far southwards as Paraguay. In *Tham. guttatus* of Spix the bill is very strong, and the inferior mandible inflated. In others it is straight and slender, with its base adorned with reversed setaceous feathers. Such is *L. plumatus*, an African species, which forms the genus Prionops of Vieillot.

In the genus Vanga (Plate CCCXC. fig. 3) the bill is large, greatly compressed throughout, the point of the upper mandible suddenly curved, the under mandible bent upwards. Example, *Lan. curvirostris*, Gmelin. In Ocypterus, Cuv. the bill is conical, rounded, scarcely arched towards the point, the termination very sharp and fine, slightly notched. The legs are rather short, and the wings long, from which characters the species have obtained the name of swallow butcher-birds; but they are as courageous as other shrikes, and do not fear to attack even crows. The species are numerous along the shores and islands of the Indian Seas, where they exhibit great agility in the capture of their insect prey. Ex. *Lan. leucorhynchos*, Gm. In Baryta of Cuv. the bill is large, conical, straight, round at the base, and encroaching on the forehead by a circular notch; the ridge is rounded, the sides compressed, the point curved. The nostrils are small and linear. The species of this genus, as well as those of Vanga, are by some combined with the crows, as part of the conirostral tribe. We may name, as an example, the piping grakle of the older writers (*Coracias tibicen*, Lath.), a native of New Holland, where it is known by the name of *Jarra-war-nang*. It preys on small birds, and is said to have a melodious voice, resembling the tones of a flute. The genus Chalybæus, Cuv. has the bill resembling the preceding, but rather thicker at the base, and the nostrils are pierced in a broad membranous space. See Plate CCCXC. fig. 6. The species are natives of New Guinea, and are remarkable for their beautiful tints of burnished steel. *C. paradisæus* has the feathers on the head and neck like frizzled velvet, and was first described by Sonnerat as a bird of paradise,—*Par. viridis*, Gmelin. In Psaris of Cuvier the bill is conical, thick, round at the base, but not encroaching on the front, slightly compressed, and curved at the extremity. The genus is founded on the Cayenne shrike of Latham, *Lanius Cayanus*, Linn.[3] It now contains many species, all classed by Mr Swainson among the Muscicapidæ or fly-catchers. Their habits are said to resemble those of the butcher-birds. The genus Grauculus, Cuv. has the bill less compressed than in Lanius, the upper ridge sharp, equally curved throughout its whole extent, the commissure or cutting edges also slightly bent. The hairs which sometimes cover the nostrils ally these species to the crows, from which they are distinguished by the notching of the bill. Their prevailing hues are ash-colour, and they are native to the Indian islands. Cuvier here places the beautiful *Irena puella* of Dr Horsfield, a Javanese species, of a fine velvet black, the back splendid ultramarine blue. It is ranged by others with the Orioles. To the same genus he likewise refers the Papuan and New Guinea crow (*C. papuensis* and *Novæ Guineæ*), and the *Piroll* of Temminck, of which the male and female differ so remarkably, the former being of a glossy blue, the latter greenish. This last species forms the genus *Ptilonorhynchus* of Kuhl,—*Kitta* of M. Lesson. It is the satin-bird of the colonists of Port Jackson, a solitary, fearful creature, which seldom leaves the cover of the umbrageous woods. The Australian natives call it *cowry*.

In Bethylus, Cuv., the bill is thick, short, bulged, slightly compressed towards the end. Its type is the magpie-shrike of Latham, *L. picatus*, an inhabitant of Guiana and Brazil. Plate CCCXC. fig. 2. In Falcunculus the bill is much compressed, almost as high as long, the culmen arched. It contains the *Lanius frontatus* of New Holland. The genus Pardalotus (which M. Lesson places with the tit-mice, and Mr Swainson with the manakins) is likewise constituted by a New Holland species, the *Pipra punctata* of Shaw. The bill is short, obtuse, convex, and slightly compressed.

All the preceding genera of the dentirostral tribe are supposed by Baron Cuvier to be more or less allied to *Lanius* of Linnæus. A great diversity of opinion, however, exists regarding their natural distribution; and in the most recent systems they will be found differently

[1] For more minute details, the student may consult Mr Swainson's "Inquiry into the Natural Affinities of the Laniadæ or Shrikes," *Zoological Journal*, No iii. p. 289.

[2] *Illustrations of British Ornithology*, vol. i. p. 149.

[3] See *Zool. Journal*, No. vii. p. 354, and No. viii. p. 463.

and variously disposed, according to the views of each particular author.

Many of the genera next ensuing are more allied to the fly-catchers, *Muscicapidæ*; but not a few are classed by recent writers among the *Laniadæ* and *Ampelidæ*. The bill is of medium size, broad at the base, horizontally depressed, almost straight, generally wider than high, the point more or less hooked and notched. The mouth is garnished with bristly feathers projecting forwards. Their food varies according to their size and strength,—the more powerful species seizing occasionally on small birds as well as insects, the more feeble being satisfied with the latter kind of prey.

In the genus TYRANNUS, Cuv., the bill is straight, lengthened, strong, the culmen rounded, the point suddenly hooked. See Plate CCCXC. fig. 5. The species consist chiefly of Linnæan fly-catchers, with a few shrikes. They are all native to America, and, as their name implies, are fierce and domineering in their disposition. They will defend their young against the boldest aggressor, and have been seen to drive from their nesting-places even the largest birds of prey. As an example, we may here name the king-bird, or tyrant fly-catcher, of the new world, *T. intrepidus*. This species is one of the most remarkable for the boldness and intrepidity which he displays in his attacks on the strongest of the feathered race. During the earlier months of summer, indeed, his life is one continued scene of broil and battle. According to Wilson, hawks and crows, the bald eagle, and the great black eagle, all equally dread an encounter with this dauntless creature, who, as soon as he perceives a bird of prey, however powerful, in his neighbourhood, darts into the air, and quickly ascending above his supposed enemy, pounces with violence upon his back, and continues his attack till his own domains have been departed from. He is likewise in some measure obnoxious to the human race, on account of his love of bees; for he will take post on a fence or garden-tree in the vicinity of hives, and make continual sallies on the industrious tenants, as they pass to and from their never-ceasing labours. His great American biographer, however, is of opinion, that whatever prejudice may prevail against him for such depredations, he is on the whole greatly the friend of man, by destroying multitudes of insects, whose larvæ prey on the produce of the field and garden. The tyrant has been immortalised in verse as well as prose:

> Far in the south, where vast Maragnon flows,
> And boundless forests unknown wilds enclose,
> Vine-tangled shores and suffocating woods,
> Parch'd up with heat, or drown'd with pouring floods;
> Where each extreme alternately prevails,
> And nature sad their ravages bewails;
> Lo! high in air above those trackless wastes,
> With spring's return the king-bird hither hastes;
> Coasts the famed gulf, and from his height explores
> Its thousand streams, its long indented shores,
> Its plains immense, wide opening on the day,
> Its lakes and isles, where feather'd millions play:
> All tempt not him: till gazing from on high,
> Columbia's regions wide below him lie;
> There end his wanderings and his wish to roam,
> There lie his native woods, his fields, his home;
> Down, circling, he descends from azure heights,
> And on a full-blown sassafras alights.
> Fatigued and silent, for a while he views
> His old-frequented haunts, and shades recluse;
> Sees brothers, comrades, every hour arrive,—
> Hears, humming round, the tenants of the hive;
> Love fires his breast,—he woos, and soon is blest,
> And in the blooming orchard builds his nest.

The king-bird migrates in summer at least as far north as the fifty-seventh parallel. It reaches Carlton House in the month of May, and retires southward in September. A new species has been of late years discovered on the banks of the Saskatchewan, but nothing is yet known of its habits. It is described by Mr Swainson under the title of *Tyrannus borealis*. It is considerably smaller than the preceding, and may at once be distinguished by its forked tail, not tipped with white.[1] The other species are numerous.[2]

A still more extensive genus is that named MUSCIPETA, Cuv. The bill is long, much depressed, twice as broad as high even at the base, the culmen usually very blunt, the margins forming an oval curve, the point feebly notched, and the base covered by long, setaceous feathers. The general form of the species is feeble compared with that of the preceding, and they prey exclusively on insects. They are extremely beautiful, often adorned by crests upon the head, or by gracefully elongated feathers in the tail. The majority are native to Africa and India. The paradise fly-catcher of Le Vaillant may be named as an example.

In the genus PLATYRHYNCHUS of Desm., the bill is short, and still broader and more depressed than in the preceding. *P. cancromus* inhabits Brazil. These birds are by some conjoined with *Todus*, to which they are assuredly allied. Certain species, of which the feet and legs are long and slender, and the tail extremely short, form the genus CONOPHAGA of Vieillot. The fly-catchers properly so called, genus MUSCICAPA, Cuv., have the beard or bill-feathers less extended than in *Muscipeta*, and the bill itself is narrower, the ridge or culmen is distinctly marked, the margins straight, the point slightly bent. The species are peculiar to the ancient continent, and not more than four or five occur in Europe. Of these, two are British, *M. grisola*, or the spotted fly-catcher, a well-known and common species; and *M. luctuosa*, or the pied fly-catcher, which is very rare. We have seen it on the banks of the Eden in Cumberland. Both are birds of passage. The species of this genus take their insect prey upon the wing, darting upon it at intervals from some favourite twig. The males and females differ considerably in their markings, especially in spring and summer, although the former sex (at least in *M. albicollis*, Temm.) are scarcely to be distinguished from the latter throughout the winter season. The modifications in the form of the bill in this extensive genus have led to the formation, so far as concerns exotic species, of a vast number of sectional groups, or subgenera, the characters of which we cannot here detail.

We now arrive, in accordance with Baron Cuvier's system, though not, we fear, by natural transition, at the genus GYMNOCEPHALUS, of which the beak resembles that of *Tyrannus*, except that the ridge is more arched, and a great portion of the face is bare of feathers. See Plate CCCXC. fig. 8. There seems to be only a single species, commonly called the bald crow (*G. calvus*), a bird about the size of a rook, of a uniform tobacco-brown colour, the feathers of the wings and tail black. It is called *oiseau mon père* by the Creoles of Cayenne, probably from its capucin aspect. Its bald front bestows upon it a very singular physiognomy. Vaillant regards the absence of feathers on that part as accidental; and he mentions in a note,[3] that he received a specimen from Cayenne, in which the face was plumed. But M. Lesson states that he has examined more than twenty specimens, and has always found the face unfeathered.

The genus CEPHALOPTERUS, on the contrary (see Plate

[1] See *Fauna Boreali-Americana*, part ii. pl. lxxxv.
[2] Consult Mr Swainson's "Monography of the Tyrant Shrikes of America," *Journal of the Royal Institution*, No. xl.
[3] *Histoire des Oiseaux de Paradis*, t. i. p. 109.

Insessores. CCCXC. fig. 4), has the front adorned by a very peculiar tuft of feathers, which, rising upwards, and then spreading around and drooping downwards, shades the head, as it were, beneath a parasol. Another expanded and lengthened set of plumes hangs in an apron-like fashion from the breast. The prevailing plumage is deep black, the parts first mentioned having a metallic lustre. The bill of the only species known (*C. ornatus*) is robust, the mandibles nearly equal, the upper being convex, without notch, and scarcely bent at the extremity. This bird was *brought* to Paris, from the Lisbon Collection, by M. Geoff. St Hilaire, and was believed to have been sent originally from Brazil. As that country, however, has been so much explored without the Cephalopterus having ever since been met with, it is more likely, M. Temminck thinks, to have been obtained in the less-frequented countries of Peru, or the coast of Chili. On the other hand, M. Lesson alleges, that he was informed by a well-instructed Portuguese, that the bird in question came from Goa. It is the *Coracina cephaloptera* of M. Vieillot. We have no doubt it is a South American species.

From these singular birds we proceed to the Cotingas or chatterers, genus Ampelis, Linn., a varied and beautiful family, now partitioned into several minor groups. They have all the depressed bill of the fly-catchers in general, but it is rather shorter in proportion, broadish, and slightly arched.

Those in which the bill is the strongest and most pointed, with dilated margins, are characterized by an insectivorous regime. These are the *piahaus* of South America, genus Querula, Vieil. The species fly in troops through the forests. Here are placed the *Cotinga rouge* of Vaillant, or *Ampelis phœnicia*, also the *Ampelis cinerea* and *Muscicapa rubricollis* of Gmelin. In the ordinary Cotingas (or genus Ampelis properly so called) the bill is more feeble, little elevated, deeply cleft. The species inhabit moist places, and are remarkable for the rich and lustrous plumage of the males during the breeding season. We here place the *Ampelis pompadoura*, *carnifex*, and *cotinga*, Linn. In the genus Bombycilla, Brisson, which includes our European or Bohemian chatterer, the head is ornamented by an elongated crest, and the majority of the species have the secondary feathers of the wings terminated by a small oval expansion, resembling a bit of scarlet sealing-wax. These birds prefer wild fruits to insects. The appetite of the American species (*A. Americana*) is stated by Mr Audubon to be of so extraordinary a nature as to prompt it to devour every fruit and berry in its way. In this manner it will gorge itself to such excess as to be sometimes unfit to fly, and may then be taken by the hand. "I have seen some which, though wounded and confined to a cage, have eaten apples until suffocation deprived them of life."[1] Our author adds, however, that they are also excellent fly-catchers, spending much of their time in pursuit of winged insects. They become very fat during the fruit season, and are then so tender and juicy as to be much sought for as an article of epicurean diet. They inhabit the United States throughout the year. The habits of the European wax-wing (*A. garrula*) are much less known. It not unfrequently visits Britain during winter, and is supposed to breed within the arctic circle. It likewise inhabits North America, but has not been observed to the southward of the fifty-fifth parallel. Dr Richardson observed a flock of three or four hundred on the banks of the Saskatchewan in May. During their trips to Britain they feed, when they can get them, on the berries of the mountain ash; and Sir William Jardine found the stomachs of one or two killed near Carlisle to be crammed with holly berries. A third species was some time ago discovered by Dr Seibold in Japan. It is the *B. phœnicoptera* of Temminck, and wants the wax-like appendages to the wings.

In the genus Casmarhynchus, Temm., the bill is remarkably broad, greatly depressed, soft and flexible at the base, of a harder consistence, and somewhat compressed towards the extremity. The nostrils are large and open, and placed far forward on the bill. As an example, we may name that singular bird the araponga (*Cas. nudicollis*, Temm. *Pl. Col.* 368–83), a Brazilian species, remarkable for the metallic resonance of its cry, which sounds like the clinking of a blacksmith's hammer. By reason of this peculiarity, it is known to the Brazilians by the name of *O. ferrador*, or the blacksmith. The adult male is pure white, the face and front of the neck nearly bare, of a green colour, sprinkled with a few small black feathers. The female is green, spotted on the under parts with white, the upper plumage of the head nearly black. The young at first resemble the mother, and adolescent males are found with a mingled plumage of green and white. Another species, of nearly corresponding plumage, is distinguished by a long, fleshy, sometimes slightly feathered caruncle, hanging from the basal front of the upper mandible. It is erectile, and sometimes projects upwards. This is the *Ampelis carunculata* of the older systematic writers. We presume it to be also the *Campanero* of the Spaniards, called *dara* by the Indians, and bell-bird by the English. "It is about the size of a jay," says Waterton. "His plumage is white as snow. On his forehead rises a spiral tube nearly three inches long. It is jet black, clothed all over with small white feathers. It has a communication with the palate, and when filled with air looks like a spire; when empty, it becomes pendulous. His note is loud and clear, like the sound of a bell, and may be heard at the distance of three miles. In the midst of these extensive wilds, generally on the top of an aged mora, almost out of gun reach, you will see the campanero. No sound or song from any of the winged inhabitants of the forest, not even the clearly pronounced 'Whip-poor-will,' from the goat-sucker, causes such astonishment as the toll of the campanero. With many of the feathered race, he pays the common tribute of a morning and an evening song; and even when the meridian sun has shut in silence the mouths of almost the whole of animated nature, the campanero still cheers the forest. You hear his toll, and then a pause for a minute; then another toll, and then a pause again; and then a toll, and again a pause. Then he is silent for six or eight minutes, and then another toll, and so on. Actæon would stop in mid chase, Maria would defer her evening song, and Orpheus himself would drop his lute, to listen to him, so sweet, so novel, and romantic is the toll of the beautiful snow-white campanero. He is never seen to feed with the other Cotingas, nor is it known in what part of Guiana he makes his nest."[2] In a third species (*Amp. variegata*, Gmel. *Pl. Col.* 51, Plate CCCXC. fig. 10) the front of the throat is all beset with numerous fleshy worm-shaped appendages. All these birds are vaguely said to feed upon insects, but on no authority that we can find. "Could we but know," says Mr Swainson, "the habits and economy of these singular birds, which, had they not been seen, might be thought fabulous, what an interesting page of nature's volume would be unfolded! Yet at present we only know that they live in the deepest and most secluded forests of tropical America, where they subsist upon an infinite variety of fruits unknown to Europeans. They are much oftener heard than seen, since their notes are particularly loud, and are ut-

[1] *Ornithological Biography*, vol. i. p. 227.

[2] *Wanderings in South America*, p. 121.

tered morning and evening from the deepest recesses of the forests. We have sometimes caught a distant view of them, perched upon the topmost branches of the loftiest trees."[1]

In the genus Procnias (now more restricted than by Hoffmansegg) the bill is likewise very broad, and deeply cleft, but the structure is firmer, and the upper mandible more convex. The nostrils are basal. Example, *P. ventralis*, Illiger, *Pl. Col.* 5.

In the not very closely allied genus Ceblepyris, Cuv. which Mr Swainson classes as the most aberrant division of the shrikes, the bill resembles that of the Cotingas, but the shafts of the rump-feathers are sharp pointed. These birds inhabit chiefly Africa, and prey on caterpillars. Example, *C. phœnicopterus*, Temm. *Pl. Col.* 71.

The genus Gymnodera, Geoff. (which forms a portion of the *Coracinæ* of Vieillot), has the bill stronger than in any of the preceding *Ampelidæ*, the neck is partially bare, and the head covered with velvety feathers. There does not seem to be more than one species (*G. nudicollis*), described by Shaw under the name of bare-necked grakle. It was classed by Gmelin and Latham as a crow,—the *Corvus nudus* of their respective works.

The Drongos (genus Edolius, Cuv.) have the bill partially depressed and notched, and its upper ridge sharp; but it is distinguished by both mandibles being slightly arched through their whole extent, and the nostrils are covered with feathers. The species are rather numerous, and are characteristic of the tropical countries of the East. The Malabar shrike of Shaw (*Edolius remifer*, Temm. see Plate CCCXC. fig. 7) affords a good example. The position of this genus ought certainly to be in closer approximation to the *Laniadæ* than it is in the arrangement of Baron Cuvier. Their habits are insectivorous, and some of the species are said to warble as sweetly as the nightingale. They usually dwell together in society, pursue bees with great avidity, and are often seen to combine in large groups on the outskirts of the forests during morning and evening. The species we have figured is a native of Java and Sumatra.

In the genus Phibalura of Vieil. the ridge of the bill is arched, as in Edolius, but shorter, broad at the base, somewhat dilated laterally, and slightly notched. The only known species is a beautiful South American bird (*Ph. flavirostris*, Vieil.; *Ph. cristata*, Swain., *Zool. Illust.* pl. xxxi.), which appears to occur chiefly in the mining districts of Brazil. It was very rare a few years back, but has now become comparatively common in collections, in consequence of several recent importations.

We come now to an extensive group, the ancient Tanagers, genus Tanagra of Linn., which, like most of the other genera, has in recent times been numerously subdivided. The bill is convex, sub-triangular at the base, the upper mandible slightly arched, curved at the point, notched, the margins flexuous and enlarged; the nasal fossæ are deep and large, and closed by a membrane; the nostrils are rounded. The wings are rather short. The Tanagers are characteristic of America. They feed both on grain and insects, and are remarkable for the beauty and brilliancy of their plumage. The following are the principal subdivisions. In Euphonia, Desm. (*Tangaras bouvreuils*, Cuv.), the bill is short, and exhibits, when viewed vertically, an enlargement at the base on either side. The tail is also short in proportion. Examples,—*Tan. violacea*, Lath.,—*Pipra musica*, Gmel.,—*Tan. diademata*, Pl. Col. 243,—and *Tan. chlorotica*, Gmel. See Plate CCCXC. fig. 9. In the genus Saltator, Vieil. (*Tangaras grosbec*, Cuv.), the bill is conical, thick, inflated, as broad as high, the culmen rounded. Such are *Tan. magna, atra, flammiceps*, &c. In the restricted genus Tanager (properly so called) the bill is short, though longer than in *Euphonia*, as broad as high, slightly compressed. Examples, *T. tricolor, thoracica, auricapilla*, &c. In the genus Tachyphonus, Vieil. (*Tangaras loriots*, Cuv.), the bill is more lengthened, conical, compressed, arched, sharp pointed. Examples, *T. cristata, nigerrima*, &c. In the genus Pyranga, Vieil. (*Tangaras cardinals*, Cuv.), the bill is strong, lengthened, the point but slightly curved, the margin of the upper mandible often strongly toothed. The wings are rather long. The habits of several of the species of this genus are better known than those of the preceding, in consequence of their more hardy constitution, which enables them to spend the summer months in North America. One of the most beautiful of these is the scarlet tanager (*Tanagra rubra*, Linn.). Among all the birds that inhabit the woods of the United States, there is none, according to Wilson, that strikes the eye of a stranger, or even of a native, with so much brilliancy as this. Seen among the green leaves, with the light falling strongly on his plumage, he appears most beautiful. His whole plumage, with the exception of the wings and tail, is of the most vivid carmine red. The wing-coverts, posterior secondaries, and middle tail-feathers, are black, and form a rich contrast to the other portions of the plumage. After the autumnal moult the male becomes dappled with greenish yellow. The colour of the female is green above and yellow below; her wings and tail are brownish-black, edged with green. Though this lovely species sometimes builds in orchards, and visits cherry trees for the sake of their fruit, it does not frequently approach the habitations of man, but prefers the solitude of the umbrageous woods, where, in addition to fruits, its food consists of wasps, hornets, and humble-bees. The scarlet tanager comes just within the limits of the fur-countries, but is unknown as yet beyond the forty-ninth degree. His nest, placed upon the horizontal branch of a tree, is built of broken flax and dry grass, so thinly woven that the light is easily seen through it. The eggs are only three in number, of a dull blue, spotted with brown; but the bird is supposed to breed more than once a year. The genus Pyranga contains also *Tan. æstiva* and other species.

We conclude our notice of the Tanagers by a brief indication of the genus Ramphoceles, Vieil., of which the bill is strong, compressed, with the sides of the lower mandible so enlarged as to spread backwards towards the cheek. Such is *Tanagra Jacapa* of Gmelin, a South American species, represented in Plate CCCXCI. fig. 2.

Our next group consists of birds more or less allied to thrushes. In all, the bill is compressed and arched, but the upper mandible is but slightly hooked, and the notching feeble. As in other extensive assemblages of species, however, the structure is considerably varied. The natural regimen is mingled, consisting both of wild fruits, worms, and insects. A few species are gregarious, the majority solitary. Of ten or twelve kinds which inhabit Europe, we have six in Britain, viz. the missel-thrush (*T. viscivorus*), the song-thrush (*T. musicus*), the field-fare (*T. pilaris*), the red-wing (*T. iliacus*), the blackbird (*T. merula*), and the ring-ouzel (*T. torquatus*). The aspect and general habits of most of these are too familiar to require illustration. The blackbird and the thrush are two of our most delightful and accustomed songsters.

> When snow-drops die, and the green primrose leaves
> Announce the coming flower, the merle's note
> Mellifluous, rich, deep-toned, fills all the vale,
> And charms the ravished ear. The hawthorn bush,
> New budded, is his perch; there the gray dawn

[1] *Natural History and Classification of Birds*, vol. ii. p. 75.

He hails, and there, with parting light, concludes
His melody. There, when the buds begin
To break, he lays the fibrous roots, and see
His jetty breast embrowned; the rounded clay
His jetty breast has soiled: but now complete,
His partner and his helper in the work,
Happy assumes possession of her home:
While he upon a neighbouring tree his lay,
More richly full, melodiously renews.

....The thrush's song
Is varied as his plumes; and as his plumes
Blend beauteous, each with each, so run his notes,
Smoothly, with many a happy rise and fall.
Sometimes below the never-fading leaves
Of ivy close, that overtwisting binds
Some riven rock, or nodding castle wall,
Securely there the dam sits all day long;
While from the adverse bank, on topmost shoot
Of odour-breathing birch, her mate's blythe chaunt
Cheers her pent hours, and makes the wild woods ring.[1]

The missel-thrush is the largest and strongest of the genus, at least in Europe. He is a bold, pugnacious bird, guarding his nest with great success from the intrusive magpie. His song is loud and clear, but monotonous; something like an ineffectual attempt to combine the tones of the thrush and blackbird. Yet Colonel Montagu admired it greatly. The ring-ouzel affects mountainous and barren places. The field-fare and red-wing are only seen with us in winter, and are known to breed in the more northern parts of Europe. The former sings well, and we have somewhere seen it called the nightingale of Norway.

One of the most noted of the foreign species of the genus is the mocking-bird of America, *T. polyglottus*, Linn. It measures about nine inches in length, is cinereous above, whitish below, with the tips of the wing-coverts, the base of the primaries, and the lateral tail-feathers white. This unrivalled Orpheus and great natural wonder of the American forests inhabits the whole northern continent from the state of Rhode Island to the larger islands of the West Indies, and, continuing through the equatorial regions, is found as far south as Brazil. Neither is it confined to the eastern or Atlantic states, being known to exist in the wild territory of the Arkansa, more than a thousand miles from the mouth of Red River. It breeds around the far western sources of the Platte, near the very base of the Rocky Mountains; and Mr Bullock observed it on the table-land of Mexico. The mocking-bird may be regarded as a permanent (we mean stationary) inhabitant of the milder regions of the western world, though such as are bred to the north of the Delaware seem to move southwards before the approach of winter.[2] The period of incubation varies with the latitude. A solitary thorn, an almost impenetrable thicket, an orange tree, cedar, or holly bush, are favourite places; and during this important period neither man nor beast can approach without being attacked. Cats are especially persecuted; yet his chief and most vengeful rage is directed against the black snake, a mortal enemy. The male bird darts upon the insidious reptile with the greatest courage, and by violent and incessant blows upon the head, sometimes deprives him of life. The boasted fascination of his race, his lurid eye, his sharp envenomed fangs, avail not when competing with the love of offspring, that pure and beautiful affection, the least selfish of all instinctive feelings. "The plumage of the mocking-bird," says the first great historian of the American feathered tribes, "though none of the homeliest, has nothing gaudy or brilliant in it; and had he nothing else to recommend him, would scarcely entitle him to notice; but his figure is well proportioned, and even handsome. The ease, elegance, and rapidity of his movements, the animation of his eye, and the intelligence he displays in listening and laying up lessons, from almost every species of the feathered creation within his hearing, are really surprising, and mark the peculiarity of his genius. To these qualities we may add that of a voice full, strong, and musical, and capable of almost every modulation, from the clear mellow tones of the wood-thrush to the savage scream of the bald eagle. In measure and accent he faithfully follows his originals. In force and sweetness of expression he greatly improves upon them. In his native groves, mounted on the top of a tall bush or half-grown tree, in the dawn of dewy morning, while the woods are already vocal with a multitude of warblers, his admirable song rises pre-eminent over every competitor. The ear can listen to his music alone, to which that of all the others seems a mere accompaniment. Neither is this strain altogether imitative. His own native notes, which are easily distinguishable by such as are well acquainted with those of our various song birds, are bold and full, and varied seemingly beyond all limits. While thus exerting himself, a bystander, destitute of sight, would suppose that the whole feathered tribes had assembled together on a trial of skill, each trying to produce his utmost efforts, so perfect are his imitations. He many times deceives the sportsman, and sends him in search of birds that perhaps are not within miles of him, but whose notes he exactly imitates; even birds themselves are frequently imposed on by this admirable mimic, and are decoyed by the fancied calls of their mates, or dive with precipitation into the depth of thickets, at the scream of what they suppose to be the sparrowhawk."[3]

The mocking-bird sometimes breeds in captivity. Many years ago a Mr Klein, of Philadelphia, partitioned off a space of twelve feet square within doors, lighted by a pretty large wire-grated window. In the centre he placed a cedar-bush, five or six feet high, in a box of earth, and scattered about a sufficient quantity of materials suitable for building. A male and female mocking-bird were introduced, and soon began to build. When the nest was completed the female laid five eggs, all of which she hatched, and she fed the young with great affection till they were nearly able to fly. Business, unfortunately, called the proprietor from home for a fortnight, and the care of the colony being left to the domestics, the result may be anticipated. On his return the young were utterly dead, and the parents nearly famished.

Several African species allied to our present group dwell together like starlings, in numerous chattering flocks, pursuing insects, and committing great depredations in gardens. Several are remarkable for the lustrous splendour of their plumage. Such are *Turdus auratus* and *nitens* of Gmelin. The Senegal species, called the glossy thrush, *T. æneus*, is characterized by the magnificent length of its caudal plumes. These richly attired species belong to the genus Lamprotornis, Temm. Other species, in which the bill is slender and lengthened (as in the Brazilian thrush of Lath.), form the genus Ixos of the last-named author; while the genus Enicurus (more nearly related, however, to the fly-catchers) consists of one or two species with a stronger bill, the tail long and forked. Such is *E. coronatus*, Temm. *Pl. Col.* 113; and *E. velatus*, ibid. 160, from Java. Grallina of Vieillot is constituted by a New Holland species with a straight, lengthened, rather rounded bill, and long legs. The plumage is black and white. Ex. *G. melanoleuca*, Vieil. The genus Trichophorus, Temm. is composed of species of which the bill is very strong, and garnished at the base with long, projecting bristles, which sometimes prevail also on the

[1] Grahame's *Birds of Scotland*.
[2] Nuttall's *American Ornithology*, i. 321.
[3] Wilson's *American Ornithology*, ii. 92.

occiput. The manners of these birds are as yet unknown. They live in Western Africa. Ex. *Tr. barbatus*, Temm. *Pl. Col.* 88.

The ant-thrushes, MYOTHERA, Illiger, come next in order. They are chiefly distinguished by their long, slender tarsi, and short tails. See Plate CCCXCI. fig. 1. The species of the ancient world, inhabitants for the most part of India, the eastern islands, and New Holland, are characterized by brilliant and contrasted colouring. These are the *Breves* of Buffon, the short-tailed crows of English writers. They form the genus PITTA of Vieillot and Temm., of which the bill is strong but thrush-like (*P. cyanurus, brachyurus*, &c.); while MYOTHERA, as now restricted, contains the American species, of much more sober plumage, with the bill more abruptly hooked, and the tooth stronger. The species dwell among the enormous ant-hills of the western world, keeping much upon the ground. They seldom fly, and certain kinds are remarkable for their deep sonorous voices. The largest, longest legged, and most singular in its general aspect, known under various names, such as long-legged crow, king-thrush, &c. (*Corvus grallarius*, Shaw; *Turdus rex*, Linn.), constitutes the genus GRALLARIA of the modern systems. It is a native of Guiana. The beautiful New Holland bird, with a bill like a thrush, but shorter, the legs long, the nails almost straight, and the lengthened tail-feathers terminated by sharp points, forms the genus ORTHONYX, and is placed by Cuvier immediately after the preceding group of ant-eating thrushes.

The genus CINCLUS, Bechstein, characterized by an almost straight, compressed, sharp-pointed bill, comprises our well-known water-ouzel, *C. aquaticus*. This interesting bird is frequent along the banks of rivers, but seems to prefer those of a somewhat rocky, alpine character. It lives in pairs, keeping always close by the stony margin of its chosen stream. The nest, according to Sir William Jardine, is formed exactly like that of our common wren, with a single entrance, and is composed of ordinary mosses, without much lining. It is usually placed beneath some projecting rock, not many yards above the water, "and often where a fall rushes over, in which situation the parent birds must dash through it to gain the nest, which they do with apparent facility, and even seem to enjoy it. At night they roost in similar situations, perched with the head under the wing, on some little projection, often so much leaning as to appear hanging with the back downwards. I recollect a bridge over a rapid stream, which used to be a favourite nightly retreat, under an arch; I have there seen four at a time sitting asleep in this manner, and used to take them with a light. Before settling for their nightly rest, they would sport in the pool beneath, chasing each other with their shrill and rapid cry, and at last suddenly mount to their perch; when disturbed, they return again in five minutes."[1] During winter they migrate to the lower streams; but in summer are most abundant on the alpine tributaries. They feed on small fish and insects, and are remarkable for their power of walking, with the assistance of their wings, beneath the surface. There is an American species (*C. Americanus*), of somewhat larger size, and of a uniform brownish slate colour. It extends along the range of the Rocky Mountains, from Mexico to Lake Athabasca. There is also an Asiatic species, figured by Mr Gould,[2] under the title of *C. Pallasii*, a name formerly bestowed on a bird supposed to come from the Crimea.

Mr Brehm has described another species by the name of black-bellied water-ouzel (*C. melanogaster*). It inhabits the north-eastern parts of the European continent, visiting in severe winters the coasts of the Baltic, where it is neither shy in its habits, nor distrustful of the presence of man. We are rather inclined, however, to distrust some of Mr Brehm's species.

The genus PHILEDON of Cuvier has the bill slightly arched throughout its whole length, compressed, broadened at the base; the nostrils are large, protected by a cartilaginous scale, and the tongue terminates in a sort of tuft. Hence the species are by many classed among the honey-sucking or tenuirostral tribes. Many of them are remarkable for some particular garniture about the base of the bill, and are found in New Holland and the eastern islands. The genus is very extensive, but not very naturally composed, as it consists of species brought from a variety of other genera, such as *Certhia*, *Merops*, *Gracula*, *Sturnus*, &c. Some have a fleshy wattle depending from the lower mandible, as in *Phil. carunculatus* of New Holland (which forms the genus CREADON of Vieillot). In others the head is partially bare of feathers, as in the *goruh*, likewise a native of New Holland, a bold and restless bird, which feeds both on insects and honey, and often puts to flight whole droves of blue-bellied parrakeets. Some have neither bare skin nor wattles, but are distinguished by a peculiar frizzled character of parts of the plumage. The poe bee-eater of Cook's voyage (*Phil. Cincinnatus*) is of this kind. It is a beautiful bird, of a glossy blackish green, with a band of white across the upper portion of the wing, and a pendent tuft of long, twisted, white feathers on each side of the neck. It is a native of New Zealand, and was formerly in great request, as contributing to ornament the feathered mantles worn by chiefs and persons of distinction. The species is also said to sing well, and is moreover highly esteemed as an article of food.

In the genus EULABES, Cuv. (*Mainatus*, Brisson; *Gracula*, Vieil.), the bill is strong, compressed, high, the culmen arched, the sides dilated towards the gape. A portion of the cheek is bare, and a fleshy appendage stretches towards the occiput from either eye. Here are placed the famous mina birds, of which two species seem to have been confounded by Linnæus under the title of *Gracula religiosa*. The specific name was first applied by misapprehension, in consequence of a Musulman woman refusing, on account of some religious scruple, to allow a European artist to make a drawing of one of these birds, which she had in captivity. Some uncertainty seems still to pervade the naming of the species. The Indian kind (*G. Indicus*, Cuv.) is somewhat larger than a blackbird, the plumage of a fine silky black, with a white spot upon the central edge of the wings, the bill and feet yellow. This bird is easily tamed, and becomes extremely familiar in confinement. It is probably the most accomplished linguist of all the feathered tribes, and may be taught to pronounce long sentences in the most clear and articulate manner. It is consequently held in high esteem, and is frequently brought alive to European countries, although it must be confessed that the purity of the English tongue is not always exhibited by the result of its maritime education. The food of the mina in a state of nature is said to consist both of fruits and insects. It greatly loves bananas, and in this country has no objection to either grapes or cherries. The larger species (*G. Javanus*, Cuv.) equals the size of a jay. See Plate CCCXCI. fig. 3. The bill is broader, more hooked at the end, but without the notch. Now M. Lesson gives the name of *Sumatranus* to this species, and

[1] Note to Wilson and Bonaparte's *American Ornithology*, vol. iii. p. 451.

[2] *Century of Birds from the Himalaya Mountains.*

Insessores.

says that the Javanese, who esteem it highly, and part with it unwillingly, obtain it only by navigation. The Indian species he has named *Javanus*, but without assigning any special reason for such transmutations. The plumage is the same in both. Old Edwards seems long ago to have indicated the two kinds. "The greater minor," says he, "for bigness equals a jackdaw or magpie; the lesser hardly exceeds a blackbird, so that the one is at least twice as big as the other." The bird described by Bontius as an Indian starling was a mina. It imitated man's voice more accurately than a parrot, and "was oftentimes troublesome with its prattle."

In the genus GRACULA, Cuv. (*Pastor*, Temm.), the bill is compressed, straight, or but slightly arched, the notch feeble, and the commissures form an angle as in the starlings. This restricted genus contains several interesting species, such as the pagoda-thrush (*G. pagodarum*), so called from its frequent occurrence among the pagodas of Malabar and Coromandel. According to Sonnerat, it is often kept caged for the sake of its song. The paradise grakle of Latham (*Par. tristis*, Linn.) also pertains to this genus. It is well named *Gracula gryllivora* by Daudin, and is remarkable, as its name implies, for the destruction of locusts. We abridge the following particulars from Buffon. The island of Bourbon, where this species was formerly unknown, was once overrun to an alarming extent by locusts, which had been accidentally introduced from Madagascar. The governor-general and the intendant of the island, alarmed at the desolation which was taking place, deliberated on the best means of extirpation, and with that view they introduced several pairs of the so-called paradise grakle from India. The plan promised to be successful; but unfortunately some of the colonists observing the birds eagerly thrusting their bills into the soil of the newly-sown fields, imagined they were in quest of grain, and spread a report that the grakles, so far from proving beneficial, were likely to be highly detrimental to the country. The case was argued in due form. It was stated on the part of the grakles, that they ransacked the new-ploughed fields, not for grain, but insects; but the opposite view prevailed, and two hours after the edict of proscription passed, not a living individual was to be found in the island. A speedy repentance followed this intemperate and hasty execution, the locusts regained their ascendency, and soon becoming more injurious than ever, the grakles were again introduced, after an absence of nearly eight years. Their preservation and extension now became an affair of state, laws were enacted in their favour, and the physicians (we presume, from policy) declared their flesh unwholesome. An opposite inconvenience, however, is said to have since arisen. The birds having prodigiously increased in numbers, and being no longer adequately sustained by insect food, have had recourse to grapes, dates, and mulberries, and have even proceeded to scratch up rice, maize, wheat, beans, and other useful produce; they enter pigeon-houses, and attack both eggs and young; and thus, after destroying the destroyer, they have themselves become a greater pestilence than that which they extirpated. There is perhaps some exaggeration in the concluding parts of this statement, as M. Duplessin, who resided several years in the island, states that the laws for its preservation are still in force. We may add, that this bird is of the same lively and imitative disposition as the mina, and is easily taught to speak. When kept near a farm-yard, or other place resorted to by different kinds of creatures, it spontaneously acquires the various cries of dogs, ducks, geese, sheep, pigs, and poultry. The manners of the genus in general resemble those of the starling. They fly in troops, searching for insect prey; their habits are familiar, their docility remarkable, and their powers of imitation almost unparalleled. The only European species hitherto classed with the grakles is the beautiful rose-coloured ouzel (*P. roseus*), which occurs in several of the warmer countries of Asia and Africa, is not unfrequent in Spain and Italy, and shows itself in other parts of Europe, more rarely as we proceed northwards. Even in Tuscany and the Lombardo-Venetian territory it is esteemed unusual. A few are recorded to have built their nests in the Florentine district in 1739. We do not know that they have been since observed to breed in Europe. They were very common in Dalmatia in 1832; and in the year following one was shot in Ross-shire.

In the genus PYRRHOCORAX, Cuv. the bill is compressed, arched, rather slender, slightly notched, the nostrils covered with feathers. We have two European species, according to Temminck's views, viz. the alpine crow of Latham (*P. pyrrhocorax*), and our own red-legged crow (*P. graculus*). The former inhabits the highest of the Northern and Helvetian Alps, seldom showing itself during the summer season at any distance from the regions of perpetual snow; the latter is also mountainous, but more widely spread over countries of less elevation. It is not unfrequent along many of the rocky coasts of England and Wales, is frequent in the Isle of Man, and occurs occasionally along the western shores of Scotland, and in Colonsay and other islands. Baron Cuvier places this bird alongside the hoopoes, as a tenuirostral genus called FREGILUS.

In the genus ORIOLUS the bill resembles that of the thrushes, but is more powerful. The legs are shorter, and the wings rather more lengthened. As now restricted, this genus contains only the species of the ancient continent, those of America (*Icterus*, *Cassicus*, &c.) being included among the conirostral tribes. The golden oriole (*Oriolus galbula*) is one of the most beautiful of European birds. It occurs occasionally in Britain. It breeds in many parts of the European continent, arriving in spring and departing in autumn. It builds on the tops of trees, its nest being attached to and partly suspended from a forked branch. This species feeds on fruits and insects, and is particularly fond of figs. The Italian peasants suppose its cry to signify "Contadino, é maturo lo fico?" Its own flesh is of most excellent flavour, especially in autumn, when having for a time fared sumptuously on the best of fruits, it has become extremely fat. The rich plumaged regent bird of New South Wales (*Sericulus chrysocephalus*, Swainson) is by some regarded as an oriole.

The genus GYMNOPS, Cuv. possesses the strong bill of the orioles, but a great part of the head is bare of feathers. In some of the species there is a prominence on the base of the beak. Such are the knob-fronted bee-eater of White[1] (*Merops corniculatus*), figured by Vaillant under the name of corbicalao (*Ois. d'Amérique et des Indes*, pl. 24), and the cowled bee-eater (*Merops monachus*, Latham). The tongue is said to be tufted like that of *Philedon*. To the genus Gymnops Cuvier also refers the bald grakle (*G. calva*, Linn. and Lath.), a remarkable species, native to the Philippine Islands, where it is said to build in the hollows of the cocoa-nut tree. It feeds on fruits, and is extremely voracious.

In the genus MENURA, Shaw, the bill is straight, somewhat triangular at the base, compressed, the nostrils lengthened, central. Region of the eyes bare. Feet large and strong. The only known species of this singular and somewhat anomalous genus, the lyre-tail of New Holland (*M. lyra* or *superba*), is characterized by the great extension and peculiar structure of the tail-feathers. (See Plate CCCXCI. fig. 4.) It is equal in size to a pheasant.

[1] *Voyage to Botany Bay*, p. 190.

The general plumage is brown. The tail of the female is of the ordinary structure. This bird inhabits rocky districts. Though placed in its present station by Cuvier, it certainly seems more allied to the gallinaceous than the passerine order. Its history, however, is still obscure, and its anatomical structure, we believe, has not yet been investigated.

From the last-named genus, it would appear an abrupt and bold transition to the feeble-bodied, soft-billed stone-chats, warblers, wagtails, and other *Sylviadæ*, all of which, however, Baron Cuvier has here grouped as intermediate between *Menura* and *Pipra*. They form a very numerous assemblage, all characterized by a rather straight and slender bill, but varying, on the one hand, by the depression of the mandibles, towards the fly-catchers, and on the other, by its compression and curvature, towards the straight-billed butcher-birds. The Sylviadæ or warblers are divided by Mr Swainson into the five following sub-families, viz. 1st, *Saxicolinæ* or stone-chats, in which the bill is depressed at the base, the gape furnished with diverging bristles, the feet lengthened, the tail rather short, the head large; 2d, *Philomelinæ* or nightingales, in which the general structure is larger and more robust than in the typical warblers, and the feet more formed for perching; 3d, *Sylvianæ* or true warblers, of which the size is very small, the structure weak, the bill very slender, straight, with the under mandible much thinner than the upper; 4th, *Parianæ* or tit-mice (placed by Cuvier in the conirostral tribe), in which the bill is either entire or very slightly notched, and more or less conic, the hind toe large and strong, and the lateral toes unequal; 5th, *Motacillinæ* or wagtails, in which the bill is lengthened, straight, and slender, the legs long, and formed for walking, the hind toe elongated, and the tail narrow and lengthened.[1] Mr Swainson has elsewhere remarked, that the Sylviadæ might be termed "ambulating fly-catchers," since, when viewed collectively, they are only separated from the *Muscicapinæ* by a different mode of feeding, indicated by the superior length and structure of their feet,—these parts being adapted for constant locomotion, either among branches or upon the ground; while in the true fly-catchers the feet are short, small, and feeble, in accordance with the sedentary habits of the species. "Comparing the warblers, on the other hand, with the thrushes, we see that the best distinction between the two groups lies in the very character which assimilates the *Sylviadæ* to the fly-catchers, namely, the basal depression of the bill. We allude, of course, to typical examples; since all these distinctions are softened down, in proportion as the three groups approximate.[2] We shall now proceed with our exposition of Baron Cuvier's system.

The genus Saxicola, Bechstein, has the bill slightly depressed and broadened at the base. The species of this genus seem confined to the ancient continents and New Holland. They feed on insects, build on the ground or among heaps of stones, and usually frequent rather wild and barren places. We have three British species, the wheat-ear or white-rump (*S. œnanthe*), which is migratory, and arrives with us in early spring, frequenting commons and mountain pastures, but also occurring in more cultivated places, though always preferring open districts; the whin-chat (*S. rubetra*), likewise migratory, but later in its arrival, and frequenting moorlands and commons covered with furze or low brushwood, where it is almost always seen to alight upon the topmost spray; and the stone-chat (*S. rubicola*), which resides in Britain throughout the year, and is often found in moistish places. Of these the white-rump is the most esteemed as food, being compared by many to the ortolan. It is much sought after in Italy, that "land of song," where, by the strangest mal-association, a man no sooner hears a feathered warbler sing than he desires to shoot and eat it. Even in the southern parts of Britain it is much esteemed; and Pennant tells us, that as many as 1840 dozen have been taken in a single season at East Bourne, in Essex. In the south of Europe it is usually captured by means of a peculiar net, and the lure of a living owl; with us a noose of horse-hair placed between two upraised or inclined portions of turf, between which the bird attempts to pass in search of insects, is found sufficient. In regard to the stone-chat, Temminck mentions that, though stationary in Africa, in Europe they are birds of passage. It is singular in this case that they should remain throughout the year in Britain. The fact that they do so, however, is undoubted, as we have ourselves shot them on the Pentland Hills when the ground was covered with snow. Signor Savi mentions that they are stationary in Tuscany, although "per il tempo del caldo maggiore dell' estate, e dell autunno, molti abbandonano le pianure, e si retirano sù i monti per cercare luoghi più freschi."[3]

In the genus Sylvia of Wolf and Meyer (*Ficedula*, Bech.) the bill is merely a little narrower at the base than in the preceding. The generic title, however, has been variously applied of late, by different writers, to their restricted groups,—Mr Selby using it to designate our willow and wood wrens, while Cuvier makes it contain, among others, the four following British species, viz. the red-breast (*S. rubecula*), the blue-throat (*S. suecica*), the common red-start (*S. phœnicurus*), and the black red-start (*S. tithys*). Of these, the second and fourth can scarcely be regarded as otherwise than of accidental occurrence in England, and have never been seen in the northern quarters of the island. The red-breast is perhaps the most beloved of British birds, and is remarkable for its combination of familiarity and independence. When left to its "own sweet will," it enters houses freely in cold or snowy weather, will perch night after night on corniced book-case, or seek repose upon the golden scallop of a picture frame; but it hates all forwardness in others, and will not voluntarily come in contact with any hand, however beautiful. It hops delighted, singing as it goes with low and plaintive note, along the comfortable carpet, or darting up suddenly towards the window-frame, will utter a louder gush of angrier melody on seeing some orange-breasted brother, perched on leafless spray, still braving the increasing darkness. For a time, just before nightfall, he seems himself to suffer from some uneasy instinct, or probably desires, from habit, to secure his usual perch in old fantastic yew or thick screened holly; but, on second thoughts, he soon assumes some quiet corner, above the reach of curious children's hands. Not seldom when the evening fire burns brightest, he descends on muffled wing, his large and liquid eye dilated less with fear than quiet wonder, and after a brief survey, he re-ascends his place of safety. Although this bird remains about our doors throughout the summer, building near out-houses and in orchards, yet

> Some red-breasts love amid the deepest groves
> Retired to pass the summer days. Their song
> Among the birchen boughs, with sweetest fall
> Is warbled, pausing,—then resumed more sweet,
> More sad, that to an ear grown fanciful,
> The babes, the wood, the men, rise in review,
> And robin still repeats the tragic line.

We have a notion, that in Scotland the female red-breast is migratory. At least, in the vicinity of Edinburgh, we recognise her not throughout the long-enduring winter. All the individuals then about our gardens *sing* and *fight*, till, in the month of March, some strangers show themselves, but do not sing, and are immediately followed and

[1] *Nat. Hist. and Classif. of Birds*, ii. 238.
[2] *Fauna Boreali-Americana*, part ii. p. 20.
[3] *Ornitologia Toscana*, i. 231.

Insessores. *fed* by the resident males, at which time they (the supposed females) utter a low hissing note, and flutter their wings like young dependent birds. This we have often seen, and vouch for.

The red-start is a rarer species. It haunts retired well-wooded lanes, where the timber is in a better state than the stone dikes; for it highly approves of the latter when old, moss-covered, and full of holes. It is a bird of passage, and although greatly less familiar than the red-breast, we have seen it build beneath the cottage eaves. It is an active, restless bird, easily recognised by its snow-white forehead, black throat, ashy back, and fine reddish orange breast and rump, to say nothing of the constant vibratory motion of the tail.

The blue bird of America (*Sylvia sialis*) has the whole of the upper plumage of a fine blue, while the throat, neck, breast, and flanks, are bright orange brown. In general character and movement this bird resembles the European red-breast, and may be said to be as familiarly known in summer to the children of America as the robin is to ourselves. Wilson informs us that its society is much courted by the inhabitants of the country, and that few farmers neglect to provide for him a snug little summer-house, ready fitted, and rent free. He is migratory over the northern districts, but a few remain throughout the winter in some parts of the United States. A more recently described species, nearly allied to the preceding, was procured by Dr Richardson at Fort Franklin, and is named by Mr Swainson *Erythaca arctica*. Its colour is a fine ultra-marine blue above, beneath greenish blue, whitish on the lower part of the abdomen, and under tail-coverts. It seemed to be merely a summer visitant of the fur-countries, and no other knowledge of its haunts or habits has been yet obtained.

The genus Curruca, Bechstein, has the bill straight, slender throughout, a little compressed anteriorly, the upper mandible slightly curved towards the point. It contains that prince of European songsters, the nightingale (*C. luscinia*), a bird of shy and unobtrusive disposition, seldom seen in open places, but loving the protection of a close entangled undergrowth of brakes and bushes. Its powers of song are generally admitted to be unrivalled, although the effect is no doubt enhanced by the solemn stillness of the summer night, when every other voice has sunk to rest,—for then

> The wakeful bird
> Sings darkling, and in shadiest covert hid
> Tunes *her* nocturnal notes.

The words of the divine Milton are sacred; yet we know not that the female sings. It is a curious coincidence, however, that she should be asserted so to do by Pliny. Our British nightingales never venture farther north than Doncaster, although in Sweden and the northern parts of Germany they are less restricted in their summer movements. To this genus belong several other excellent British songsters, such as the rich-voiced black-cap (*C. atricapilla*), the greater petty-chaps (*C. hortensis*), and the white-throat or muggy (*C. cinerea*). These, as well as the following, are called abroad *fauvettes*.

A few species which affect damp underwood and reedy marshes, such as the grasshopper warbler (*S. locustella*), the sedge-warbler (*S. phragmitis*), and the reed-wren (*S. arundinacea*), constitute the genus Salicaria of Mr Selby. To the same little group, we doubt not, belongs the *beccamoschino* of the Tuscans (*Sylvia cisticola*, Temm.), remarkable as exhibiting the propensities of a tailor-bird. The nest is placed near, but not upon the ground, usually in a bush of lengthened herbage, the leaves and stalks which form the external covering being drawn together, while a flooring for the nest is made somewhat lower down, by curving the leaves across. The beauty of the structure consists in this, that the latter are not supported by their mutual interlacement, but are sewed together, sometimes by spiders' webs, sometimes by thread-like portions of various plants. The interior is chiefly composed of vegetable down. The nests constructed in April are much less finished than those of August, owing to the absence, in the earlier month, of several materials which greatly conduce towards their elegance and solidity.[1]

Another limited genus, called Accentor, has the bill also slender, but rather more conical than the other Sylviæ, with the edges slightly bent inwards. The species are much more hardy than the preceding (all of which are birds of passage); and our only British representative, commonly called the hedge-sparrow (*A. modularis*), remains with us throughout the winter. It seems characteristic of the northern parts of Europe, being seldom seen in France except during winter; and the few that occur in Italy are known to breed among the mountains, only descending to the plains when the summer heat is over. With us what school-boy knows not its mossy, twig-entangled nest, and pure unspotted eggs of greenish blue? A larger and still hardier species is the alpine warbler (*A. alpinus*), of the accidental occurrence of which in the garden of King's College, Cambridge, an instance is recorded by Mr Selby. This bird is an inhabitant of the most mountainous regions of Europe, and particularly affects those districts which are of an abrupt and rocky character. It is common among the Alps of Switzerland, and may be usually seen in the environs of the convent of St Bernard. In summer it ascends to a great elevation, where it breeds beneath the ledges of the rocks, laying four or five eggs of a greenish-blue colour. As winter advances, and the snow begins to gather amid the desolate steeps, it descends towards the vales and middle regions of the mountains, where it subsists upon the seeds of alpine grasses, and of other plants. In summer it destroys grasshoppers, and various insects, and their larvæ.[2]

In the genus Regulus, Cuv., the bill is still slender, but conical, sharp pointed, and the sides, when viewed from above, are slightly concave. The species are much more active and arboreal than those last named. We may mention as an example our beautiful golden-crested wren (*R. auricapillus*, Selby; *Mot. regulus*, Linn.), the smallest of British birds. It inhabits woods and forests, and flits rapidly from tree to tree, examining the leaves and branches in search of insects. Its manners resemble those of the tit-mice, in company with which it often travels. Mr Selby has recorded, that after a severe gale from the north-east, *thousands* of these tiny creatures were seen to arrive upon the sea-shore and sand-banks of the Northumbrian coast,—many of them so fatigued as to be unable to rise again after alighting on the ground. In this genus Cuvier retains our willow or yellow wren, and lesser petty-chaps (*M. trochilus* and *hippolais*), which most other modern writers keep apart in their restricted genus Sylvia, bestowing other titles (*Erythaca*, *Phœnicura*, *Philomela*, &c.) on the genus which Cuvier has so called. These transpositions are the bane of Ornithology. Several true Reguli inhabit North America.

Our common (kitty) wren forms, with certain foreign species, the genus Troglodytes of Cuv. The bill is rather more slender than in Regulus, and slightly arched.

The generic name of Motacilla, of such extensive application in the older systems, is now restricted to the wag-tails, such as *M. alba* and *cinerea*, Linn. Our yellow

[1] *Nuovo Giorn. de' Letterati*, t. vi. (where the nest is figured); and *Ornitologia Toscana*, t. i. p. 282.
[2] *Illustrations of British Ornithology*, vol. i. p. 247.

species, which differs from the others in being a bird of passage, is moreover distinguished by an arched and lengthened hind claw, and forms the genus BUDYTES, Cuv., founded, perhaps, upon a character of no great importance. All the wag-tails are peculiar to the ancient continent.

The genus ANTHUS, Bechstein, so long united to the true larks, has the bill straight, slender, rather subulate towards the point, the base of the upper mandible carinated, the tip slightly bent, and emarginated. The hind claw is more or less produced. We have three British species, the rock or shore pipit (*A. aquaticus*), the tit-lark or meadow pipit (*A. pratensis*), and the tree pipit (*A. arboreus*). Richard's pipit (*A. Richardi*, Vieil.) may be included in our list of accidental visitants.

The great tribe of *Dentirostres* is terminated by Cuvier with certain groups which differ from all the preceding by the closer union of the outer and middle toes, which are joined together for a considerable space, after the manner of the syndactylous tribes.

Of these groups the first is composed chiefly of the *manakins* (Genus PIPRA, Linn.), in which the bill is short, compressed, higher than broad, notched, the nasal fossæ large, the nostrils concealed by feathers. The tail and legs are short. They may be subdivided as follows.

In the genus RUPICOLA of Brisson the species are of considerable size, and their heads are ornamented by a double crest of vertical feathers. The only species known are South American, and are distinguished by the name of rock manakins. *P. aurantia*, Vieil. (*Pipra rupicola*, Gm.), is of a brilliant orange colour, with peculiar frizzled feathers on the wings and tail. It is one of the most beautiful of birds, lives on fruits, scrapes in the ground like the Gallinæ, and constructs its nest among the deep caverns of the rocks. It is shy and mistrustful, and flies with great rapidity. The female, which is of a brown colour, lays two eggs of the size of those of a pigeon. The immature birds are also brown. This species inhabits the rocks by the rivers of Guiana. Not far from the banks of the river Oyapoc, to the windward of Cayenne, is a mountain which contains an immense cavern. There also, according to Waterton, the cock of the rock is plentiful. He is of a gloomy disposition, retiring during the day among the darkest rocks, and only coming out to feed a little before sunrise and at sunset. The South American Spaniards call him *Gallo del Rio Negro*, supposing that he is only met with in the vicinity of that far inland stream; but he is common in the interior of Demerara, amongst the huge rocks in the forests of Macoushia, and has been shot south of the line, in the captainship of Para. *R. Peruviana* is a nearly allied species, of somewhat larger size, but wanting the frizzled character of the wing and tail feathers. It inhabits Peru. The female is still unknown. Our author here places the beautiful green species from Java and Sumatra (*Calyptomena viridis* of Horsfield), which he thinks differs from the other Rupicolæ chiefly in the crest not being fan-shaped. (See Plate CCCXCI. fig. 7.) The true manakins (genus PIPRA, Cuv.) are of much smaller size. They likewise inhabit America, where they dwell in the deep and humid forests, feeding, it is said, both on fruits and insects. They are in general distinguished by the rich and varied colouring of their plumage. We have figured as an example a beautiful Brazilian species, the *Pipra pareola*. (See Plate CCCXCI. fig. 5.)

The terminal group of the *Dentirostres* is formed by the genus EURYLAIMUS, Horsfield, in which the bill is much stronger and broader than in any of the preceding, being in some of the species so greatly depressed and expanded at the base, as to exceed the breadth of the head. The upper overlaps the under mandible. These birds are peculiar to India and the great eastern islands, and now amount to five or six in number, which, however, offer such disparity in the structure of the bill, as to render subdivision unavoidable. This has been in part effected; the genus CYMBIRHYNCHUS, Vigors, containing *Eu. nasutus*, while the specific name of another (*Eu. corydon*), remarkable for the extraordinary expansion of the upper mandible, is used generically by M. Lesson, the species itself being termed *Temminckii*. (See Plate CCCXCI. fig. 8.) We know little of the manners of any of these birds. When actually ascertained, they may probably be found to offer a considerable disresemblance. They have hitherto been generally found in wild and desert places, by the banks of rivers, and are supposed to feed both on fruits and insects, —a frequent, if not a safe conclusion on the part of naturalists, regarding almost every unknown species which happens to be neither a goose nor an eagle.

TRIBE 2D.—FISSIROSTRES.

This restricted tribe consists of the swallows, swifts, and goat-suckers, and is characterized by the bill being short, broad, depressed, slightly curved, without any tooth, and so deeply cleft as to give peculiar wideness to the gape,—a structure of great use to birds which prey so exclusively on insects taken on the wing. Their insectivorous regimen induces migratorial habits, and all the species leave ourselves and other northern nations so soon as the sear and yellow leaves of autumn betoken the approach of frost, and the consequent decrease or extirpation of insect life. Like the raptorial order, or birds of prey properly so called, the fissirostral tribe is capable of a binary division into diurnal and nocturnal species.

Swallows, in general (HIRUNDO, Linn.), are remarkable for their close-set, usually glossy plumage, the great length of their wings, their swift, powerful, easy, and long-continued flight. They occur in almost every region of the globe. In the restricted genus HIRUNDO, Cuv., the toes are disposed as in the majority of birds, that is, three anterior and one posterior. In some of the species the legs and feet are clothed with feathers, the hind claw is slightly disposed to turn forwards, the tail is forked, and of medium size. Such is our martin or window-swallow (*H. urbica*) which forms so cheerful a feature in many of our villages and country dwellings, building beneath the eaves of houses, or the upper angles of windows. It is glossy bluish-black above, the rump and all the lower regions white. In others the legs and feet are naked, the tail forked, and of great length. Such is our chimney-swallow (*H. rustica*), which usually builds in out-houses, and leaves the top of its nest uncovered. Its upper parts, and the higher portion of the breast, are black; the forehead and throat deep orange-brown, the lower portions of the body white. This species usually appears a few days earlier in April than the preceding. Although the migratory movements of both these birds may be still regarded as mysterious, there is now no doubt of the fact that they do migrate. It appears from the observations of M. Natterer, that they moult in February, that is, during their absence from this, the land of their nativity,—a fact which would of itself suffice to overthrow the idea of their long-protracted winter sleep. It is also in respect to other purposes as usual well ordained, for if the heavy moult which befalls so many species during spring or autumn, were equally to affect these long-winged birds, their flight from foreign lands, or journey thither, might be procrastinated, or prevented altogether. Swallows are probably the most purely and exclusively insectivorous of all birds, and even if they could themselves withstand our winter's cold, they would soon perish miserably from want of food.

This extreme sensibility of course renders it difficult to keep swallows caged, or otherwise confined, throughout the winter season. Yet several instances are known

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of their surviving that inclement period. The following is given by Mr Bewick, on the authority of the late Sir John Trevelyan. The experiments were made by a Mr Pearson. "Five or six of these birds were taken about the latter end of August 1784, in a bat-fowling net, at night; they were put separately into small cages, and fed with nightingale's food. In about a week or ten days they took the food of themselves: they were then put altogether into a deep cage, four feet long, with gravel at the bottom; a broad shallow pan with water was placed in it, in which they sometimes washed themselves, and seemed much strengthened by it. One day Mr Pearson observed that they went into the water with unusual eagerness, hurrying in and out again repeatedly with such swiftness as if they had been suddenly seized with a frenzy. Being anxious to see the result, he left them to themselves about half an hour, and on going to the cage again found them all huddled together in a corner apparently dead; the cage was then placed at a proper distance from the fire, when two of them only recovered, and were as healthy as before—the rest died; the two remaining ones were allowed to wash themselves occasionally for a short time only; but their feet soon after became swelled and inflamed, which was attributed to their perching, and they died about Christmas. Thus the first year's experiments were in some measure lost. Not discouraged by the failure of this, Mr Pearson determined to make a second trial the succeeding year, from a strong desire of being convinced of the truth respecting their going into a state of torpidity. Accordingly, the next season having taken some more birds, he put them into the cage, and in every respect pursued the same methods as with the last; but to guard their feet from the bad effects of the damp and cold, he covered the perches with flannel, and had the pleasure to observe that the birds throve extremely well. They sang their song through the winter, and soon after Christmas began to moult, which they got through without any difficulty, and lived three or four years, regularly moulting every year at the usual time. On the renewal of their feathers, it appeared that their tails were forked exactly the same as in those birds which return hither in the spring, and in every respect their appearance was the same. These birds were exhibited to the Society for promoting Natural History, on the 14th February 1786, at the time when they were in a deep moult, during a severe frost, when the snow was on the ground. They died at last in the summer, from neglect during a long illness which Mr Pearson had, who concludes this interesting account with the following words: 'January 20, 1797.—I have now in my house, No. 21 Great Newport Street, Long-Acre, four swallows in moult, in as perfect health as any birds ever appeared to be in when moulting.'"[1] Our only other species is the sand-swallow, or bank-martin (*H. riparia*), of smaller size and browner colour. It is the earliest of the genus; but being more locally distributed, its arrival in many districts is not so speedily observed.

Among the foreign species, one of the most remarkable is *H. esculenta*, a small brown swallow, from the Indian Archipelago. Its nest, formed chiefly of a peculiar kind of sea-weed, is very mucilaginous when cooked; and its restoratory virtues are held in such high esteem, that it has become with eastern nations, especially the Chinese, a most important article of commerce. The best kinds (such as are white and transparent, and of a uniform and delicate texture) sell at from a thousand to fifteen hundred dollars the peckul (not more than twenty-five pounds). The Dutch alone were in use to export from Batavia about a thousand peckuls every year; but of these, a great proportion was brought from the islands of Cochin-China, and others to the eastward. However, these nests are nowhere more abundant than about Croee, near the south end of Sumatra. They weigh each about half an ounce, and resemble a small saucer in shape, with one side flattened, by which they adhere to the rocky walls of caverns. Their texture resembles that of isinglass, or fine gum-dragon. When about to be used they are soaked, then pulled to pieces; and after being mixed with ginseng, are put into the body of a fowl, which is stewed all night with a sufficient quantity of water. When dissolved in broth they are said to give it a delicious flavour.[2] Naturalists are not agreed as to the exact mode of formation of these nests. Some suppose them the result of a glandular secretion. Alexander Wilson says, that the aculeated swallow (*H. pelasgia*) of America fastens together the twigs which compose its nest by means of a strongly adhesive gummy matter, secreted by two glands placed on each side of the hinder portion of the head.[3]

The swifts belong to the genus Cypselus of Illiger, distinguished by the extreme shortness of the legs, and the peculiar character of all the four toes being directed forwards. The middle and outer toes have only three articulations. Of all the feathered race, these are perhaps the most vigorous and unwearied flyers. Even in the skeleton, the shortness of the humerus, the breadth of its apophyses, the oval form of the fourchette, and the sternum unnotched below, indicate a structure admirably suited to sustain aërial motion; and when to these we add the enormously lengthened primary feathers of the wings, we have a flying machine of the most powerful kind. We doubt not that during every summer evening in which these sable creatures pursue their gladsome gambols through the unresisting air, they travel many hundred miles. It is easy to observe, that they are often on the wing incessantly for hours together, careering in fine weather in vast and intersecting circles, screaming after each other in no melodious strains, and flying at such a maddening rate as if flight were the only faculty worthy of exercise in earth or heaven; and we are sure that the same genius for arithmetic which enables a school-boy to ascertain how many grains of barley would surround the world, might, if applied to every minute's flight of this surprising bird for one "purpureal eve," elicit a result in distance which would astonish even a railway engineer. Our common swift is the *Cypselus murarius* of Temm. (*Hirundo apus*, Linn.). These birds, as well as swallows, seem in many instances to return to the same spot for a series of years. Dr Jenner took two claws from the foot of twelve swifts. Several were re-taken in the course of one or two seasons; and at the expiration of seven years, one was brought in by a cat. A larger species (*C. alpinus*, Temm.), frequent among the Alps of Switzerland and the Tyrol, and well known at Gibraltar, has occurred occasionally in Ireland. There are a great many foreign species, both of swifts and swallows.

In the genus Caprimulgus, Linn., the gape is still wider, and the beak is bristled at the base with stiffish hairs. The wings are very long, the legs short, the tarsi usually feathered, the toes united at the base by a membrane, slightly connecting even the hinder toe, which is somewhat versatile; the middle toe is often toothed on its inner edge (see Plate CCCXCI. fig. 6 *a*); and the outer one, by a conformation of rare occurrence amongst birds, has only four articulations.

The Caprimulgi or goat-suckers (an absurd and fabu-

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[1] Bewick's *British Birds*, i. 254.

[2] See Shaw's *General Zoology*, vol. x. p. 111; and Sir G. Staunton's *Embassy to China*, vol. i. p. 288, and vol. ii. p. 5. This species seems described under the name of *H. fuciphaga*, in *Act. Holm.* t. xxxiii. p. 151.

[3] *American Ornithology*, vol. ii. p. 24.

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Although the general title of goat-sucker is so familiar to our ears, we confess we were never aware of how it had originated,—deeming it some accidental and unmeaning application,—till we had read the following passage in Mr Waterton's work. "When the moon shines bright, you may have a fair opportunity of examining the goat-sucker. You will see it close by the cows, goats, and sheep, jumping up every now and then under their bellies. Approach a little nearer,—he is not shy,—'he fears no danger, for he knows no sin.' See how the nocturnal flies are tormenting the herd, and with what dexterity he springs up and catches them, as fast as they alight on the belly, legs, and udder of the animals. Observe how quietly they stand, and how sensible they seem of his good offices; for they neither strike at him, nor hit him with their tail, nor tread on him, nor try to drive him away as an uncivil intruder. Were you to dissect him, and inspect his stomach, you would find no milk there. It is full of the flies which have been annoying the herd."[2] Many an hour, during the long still summer evenings, have we watched the flight of our only British species, while it hawked for moths along the fringed margins of the rocky woods, or glanced more openly across the dewy meadows which bank the crystal basin of the "beautiful Winander,"—but we never saw it hovering around or near to any kind of cattle. We doubt not, however, that the same habit, as noted by Mr Waterton, must have been observed in Europe, and has, through misconception, originated the vernacular name.

Tribe 3d.—Conirostres.

In this tribe are comprehended a considerable variety of genera, exhibiting not a little disparity in size, structure, and habits, but agreeing in their bills being comparatively strong, more or less conical, and without notch. Several of the species, such as crows and magpies, are omnivorous; but, generally speaking, when compared with either of the two preceding tribes, the diet of the Conirostres may be termed granivorous.

The first little group is constituted by the larks, genus Alauda, Linn., of which the greater number have the bill straight, moderately thick, and pointed. (See Plate CCCXCII. fig. 1.) Though their flight is occasionally lofty and sustained, and the sky-lark (*A. arvensis*) obtains its name

From warbling high
His trembling thrilling extacy,
As, lessening from the dazzled sight,
He melts in air and liquid light,—

yet they haunt, and build their humble nests, habitually in fields of grain or grassy meadows. Even the wood-lark (*A. arborea*), although it perches and sometimes sings on trees, rears its young upon the ground. The shore-lark of Pennant (*A. alpestris*, Gmel.) is common to the northern parts of Europe, Asia, and America.

In the genus Parus, Linn., the bill is small, short, conical, straight, beset at the base with hairs, and the nostrils concealed by feathers. The species commonly called *titmice* are lively, active little birds, usually observed flying with eagerness from tree to tree in search of insects, scaling the branches in all directions, and seemingly quite regardless whether their heads or their heels are uppermost. Their nests are usually placed under cover, either in the crevice of a wall or the hollow of an old tree, and the number of eggs which they lay exceeds that of most Passeres. They eat grain and seeds, as well as insects. The species are distributed over the whole world, with the exception of New Holland, South America, and the islands of the South Pacific Ocean. Although of rather gay and beautiful plumage, they are more numerous in temperate and northern countries than between the tropics. We have seven species in Britain, of which the bearded titmouse (*P. biarmicus*) is scarce, and partially distributed, and the crested species (*P. cristatus*) so extremely rare as to be regarded as accidental. From the small size, rapid movements, and usually arboreous habits of all these birds, their doings can scarcely be observed with advantage during the umbrageous summer. But when the woods have either lost their leafy glory, or the dry red foliage hangs unresistant of the slightest breath, then are these vivacious creatures seen to congregate in little flocks, sometimes several species joining together, and cheering each other on with frequent shrilly cries. In their foraging excursions they likewise visit our gardens, shrubberies, and cottage doors, plundering the farm-yards, eating potatoes with the pigs and poultry, and greedily searching out an old marrow-bone, or (if in Scotland) a sheep's head of the preceding Sunday. The suspended nests of some of the foreign species are extremely elegant, and even that of our own long-tailed species is an object of great interest and beauty. Mr Selby describes it as usually fixed in one of the smaller forks of a tree branch, but occasionally amid the closer screen of a fir, or the centre of a thick bush of woodbine or thorn. It is of a longish oval form, composed of different

[1] *Acad. des Sciences*, Mars 1817, *Nouv. Bull.* 1817, p. 51.

[2] *Wanderings in South America*, p. 143.

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lichens and wool firmly and curiously interwoven, and lined with a profusion of feathers. A small hole is left on two opposite sides of the nest, not only for ingress and egress, but also to prevent the bird during incubation from being incommoded by its long tail, which then projects through one of the orifices. The eggs are white, with fine reddish-brown specks upon the larger end, and usually amount to ten or twelve.[1] The *Parus pendulinus*, a species of the southern parts of Europe, constructs a purse-shaped dwelling, suspended from the flexible branches of aquatic plants, or interlaced among the waving reeds. This hang-nest tit-mouse is often seen among the marshes of Bologna, where the peasantry seem to regard it with the same kindly affection as we do our red-breast.

The genus Emberiza, Linn., is distinctly characterized by its rather short, straight, conical bill, and the curved form of the gape, produced by a narrowing of the sides of the upper mandible, and a corresponding enlargement of the under one. Instead of being as usual concave within, the upper mandible has a hard, rounded knob in the inside, or what is called a tuberculous palate. The species commonly known by the name of buntings feed chiefly on seeds and grain. The ortolan (*E. hortulana*), a native of the central and southern provinces of Europe, has been occasionally killed in England. It is much esteemed in Italy and elsewhere as an article of food. It is frequently lean when first netted; but if left undisturbed and well fed, it will not only fatten rapidly, but even in many instances die of repletion. The snow-bunting, and a few other kinds, distinguished chiefly by the elongation of the hind claw, form the genus *Plectrophanes* of Meyer, now called lark-buntings by our English writers.

The great genus Fringilla of Linn. has the bill also conical, and more or less thickened at the base; but the commissure is not angularly curved, as in the preceding group. Numerous subdivisions have been made of this genus in modern times. Of these the following may be taken as examples.

In Ploceus, Cuv., the bill is rather square at the base, but sharp-pointed; the upper mandible somewhat dilated. The species are known by the name of weavers, on account of the art with which they join together the materials of their nests. Several species are gregarious, even during the breeding season, hanging their nests close together in the same tree; and as each on building a new nest forms it in close connection with the old, the final result is, that an apparently solid mass is at length collected, consisting of numerous apartments, each tenanted by a pair of birds, but having the external appearance of one gigantic dwelling. Cuvier here places the species known in the older systems as the Philippine gross-beak, *Loxia Philippina*, Linn. This bird is known in India by the name of baya, and may be rendered so tame as not only to perch upon the hand, but to fetch and carry at command. It builds a very curious nest, in the shape of a long cylinder, swelling out into a globose form in the middle, and composed of the fine fibres of leaves and grass, fastened by the end to a lofty branch, generally of the Palmyra or Indian fig-tree. The eggs are said to resemble pearls, with the white part transparent even when boiled, and are accounted delicious eating. This species is alleged to feed on fire-flies. Another remarkable Ploceus is the sociable gross-beak, or republican, *Loxia socia*, Latham. It is an inhabitant of the interior of the Cape country, and is thus described in Paterson's *Travels:* "Few species of birds live together in such large societies, or have such an extraordinary mode of nidification, as these; they build their nests on the mimosa trees, which grow to a very large size, and appear to be well calculated for the purpose, as the smoothness of their trunks prevents the birds from being attacked by monkeys, and other noxious animals. The method in which their nests are made is very curious. On one tree there could not be less than from eight hundred to a thousand under one general roof. I call it a roof, because it resembles that of a thatched house, and projects over the entrance of the nest below in a very singular manner. The industry of these birds seems almost equal to that of the bee. Throughout the day they appear to be busily employed in carrying a fine species of grass, which is the principal material they employ for the purpose of erecting this extraordinary work, as well as for additions and repairs. Though my short stay in the country was not sufficient to satisfy me by ocular proof that they added to their nest as they annually increased in numbers; still, from the many trees which I have seen borne down by the weight, and others which I have observed with their boughs completely covered over, it would appear that this is really the case. When the tree which is the support of this aërial city is obliged to give way to the increase of weight, it is obvious that they are no longer protected, and are under the necessity of rebuilding in other trees. One of these deserted nests I had the curiosity to break down, to inform myself of the internal structure of it, and found it equally ingenious with that of the external. There are many entrances, each of which forms a regular street, with nests on both sides, at about two inches distance from each other. The grass with which they build is called the Boshman's grass, and I believe the seed of it to be their principal food, though, on examining their nests, I found the wings and legs of different insects. From every appearance, the nest which I dissected had been inhabited for many years, and some parts of it were more complete than others. This, therefore, I conceive to amount nearly to a proof that the animals added to it at different times, as they found necessary, from the increase of the family, or rather of the nation or community."[2]

The genus Pyrgita, Cuv., contains the sparrows properly so called, of which the common house species (*P. domestica*) affords a familiar example. This bird is characteristic of the temperate and more northern parts of Europe, and is scarcely known in Italy to the south of Piedmont, being replaced by a closely-allied species, *P. cisalpina*, which is the *Passer volgare* of Italian authors. Although M. Temminck thinks that the manners of the latter are less domestic than those of our more northern kind, and that its love of fields and country places ally it rather to the *P. montana*, we doubt not that all who have lived in Italy will be of a contrary opinion,—in agreement with the following beautiful passage by Professor Savi, which we shall not injure by translating. "Sembra che quest' uccello non possa vivere se non con l'uomo. Eccetuate quelle regioni alpestri ove regnano perpetuamente i ghiacci, in qualunque altro luogo in cui l'uomo si è stabilito, la Passera l'ha accompagnato; e indifferente alla prospera, o contraria fortuna, essa ha posta dimora nella dimora di lui. In riva delli stagni, in mezzo alla quiete de' boschi delle Maremme, sulla povera ed umile capanna d'un piscatore o d'un pecorajo, han domicilio le passere, le quali trovano il loro cibo nella sementa di grano del piccolo campo, ne' frutti dell' orticello, nello scarso becchime gettato alle galline o a' piccioni. E nel modo stesso voi le vedete nel contro delle più grandi e clamorose città, porre il nido fra gli ornati d'una grandiosa cattedrale, o sù i tetti d'un giardin di delizia, e cercare le granella o miche di pane in mezzo alle piazze più popolate. Ma se l'uomo cessa d'abitare

[1] *British Ornithology*, i. 241.

[2] *General Zoology*, vol. ix. p. 303.

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quella capanna, o quella città, la passera anche essa l'abbandona. Chi, girando nelle maremme, passa per antiche e disabitate abbazìe, per fortilizi, o ville in rovini, vedra dalle finestre più elevate di quelle, fuggire de' piccioni insalvatichiti, udirà gridar la civetta che abita fra li spacchi de' muri vestiti d'ellera e parietaria, vedrà la ballerina continuare a fabbricarvi il nido, ma in vano egli la cercherà il volatile parasito dell' Europeo, quella specie d'uccello che prima per il numero ogni altro ne superava in quel luogo. Così nel modo stesso che una figura geometrica vista sulla sabbia fu giudicata dal naufraga Filosofo per un segno certo della vicinanza dell'uomo, per un tal segno ancora può ritenersi la presenza delle passere."[1] In regard to our own species, Savi observes, "non mi è noto se ne stiano anche in Lombardia, ma so di certo che alcuno giammai ne è stato visto in Toscana." According to Temminck, the boundary of the latter species is the great chain of the Alps, on the southern slopes of which it disappears in favour of the cisalpine kind. But it is our common British sparrow which occurs about Trieste, and through the north of Dalmatia, although separated from the region of *P. cisalpina* only by the waters of the Adriatic. "I costumi," adds the Italian author, "di queste due specie sono precisamente gli stessi. Io ho accuratamente ed in varj tempi osservate le abitudini della *F. domestica*, tanto in Svizzera che nel settentrione della Francia, e posso assicurare che le stesse sono di quelle della nostra specie Italiana."[2]

In the restricted genus Fringilla, Cuv., the bill is rather less arched than in the sparrows, and a little stronger and more lengthened than among the linnets. Cuvier includes in it the chaffinch (*F. cœlebs*), the mountain-finch or brambling (*F. montifringilla*), and the snow-finch (*F. nivalis*). The latter is scarcely ever found except in the near vicinity of ice and snow, and may be regarded (in common with *Accenter alpinus*) as the most mountainous of all the smaller birds of Europe. Yet though wild and solitary in our estimation, from associating it with the desolate scenery of the rock-surrounded glaciers, it is beautiful to see how, in the neighbourhood of the lonely shepherd chalets of the Alps, it loves to humanise its feelings; and how, among the few sad dwellings of the Mount Cenis, and other lofty passes, it perches on the roofs of houses, hops about the beaten foot-paths, and builds among dismantled yet protecting walls. In winter it seeks subalpine regions, or the snow-covered valleys of Piedmont, but scarcely ever migrates to the lowest plains. It is unknown in Tuscany.

In the genus Carduelis, Cuv., the bill is more exactly conic, without bulging in any portion, and is rather lengthened. We may name as an example, our beautiful, lively, and intelligent goldfinch (*C. elegans*, Steph.,—*F. carduelis*, Linn.), a bird widely distributed over Europe, and extending from the sultry shores of the Mediterranean to the plains of Siberia. It occurs in Holland only as a bird of passage. The siskin (*F. spinus*) is by some considered as a Carduelis, while others place it with the group which follows, viz. genus Linaria, Bechstein, in which the bill is equally conical, but not so long. Here we place our gray linnets and red-poles, among which the more or less decided crimson tinting of the breast and forehead, according to age and season, has occasioned some confusion. Our common or gray linnet (*F. cannabina*, Linn.,—*F. linota*, Gmel.) is, in the perfect nuptial plumage, synonymous with the rose-linnet and greater red-pole. Our lesser red-pole is the *F. linaria* of Linn.; and the only other British species is the twyte or mountain-linnet, *F. montium*, Gmel., formerly regarded as a bird of passage, but now known to breed in the northern counties of Scotland, if not elsewhere in Britain. We have caught the young ones, half-fledged, among the Grampian Mountains. The amount of foreign species is considerable. Of these, one of the most remarkable for its musical powers is the well-known canary (*F. canaria*, Linn.), a native of the Cape de Verd and other islands, where its natural plumage is green. It breeds readily in confinement with the linnet, goldfinch, siskin, and other species.

The genus Vidua, Cuv., contains some remarkable species, with the bill more inflated at the base than the preceding, but chiefly characterized by the extreme elongation of the caudal plumage of the males. They inhabit India and Africa, and were placed by Linnæus among the buntings.

The genus Coccothraustes, Cuv., containing the gross-beaks, has the bill very conical, but of extreme thickness at the base, and rapidly tapering to the point. The culmen is rounded, the commissure slightly arched. The species occur in America, as well as in the ancient continents. The haw-finch (*C. vulgaris*,—*Loxia coccothraustes*, Linn.) visits the southern parts of Britain occasionally during winter, and is even said to have been found breeding in Windsor Forest. It feeds upon the larger kinds of seeds and berries, which it is enabled to bruise and break at pleasure, by means of the great strength of its bill. The evening gross-beak (*C. vespertina*, Cooper) is a beautiful American species, with the frontal feathers and a line above the eye yellow, the crown, wings, and tail black, the secondaries and inner wing-coverts white, the bill pale yellow. This newly-discovered bird inhabits the solitudes of the north-western interior, being met with from the extremity of the Michigan territory to the Rocky Mountains, and it is not uncommon towards the upper end of Lake Superior and the borders of the Athabasca Lake. To the east of these regions it appears to be only a transient visitor during spring and autumn. Our homely and heavy-headed green linnet (*C. chloris*, Fleming), of which the mature male is a rich and beautifully plumaged bird, belongs to our present genus. It is probable that the *Fringilla incerta* of Risso, figured by M. Roux (in his *Ornithologie Provençale*), is nearly allied. It is one of the rarest of the European birds, appearing occasionally during the autumn in Provence, and likewise occurring in the vicinity of Palermo.

In the genus Pitylus, Cuv., are contained a few species (almost all, we believe, from South America), in which the bill, though thick, as in the preceding, is rather compressed, arched above, and has sometimes a projecting angle in the middle of the margin of the upper mandible. Such are the *Loxia grossa*, *Portoricensis*, &c.

In the genus Pyrrhula, in which the bill is shorter and greatly bulged, we have the bullfinches, of which our British species, *P. vulgaris*, Temm.,—*L. pyrrhula*, Linn., is a well-known example. It is very generally distributed throughout our wooded districts, but is nowhere very abundant, and may be called scarce in several quarters of the island.

In the genus Loxia of Brisson, as now restricted, the bill is compressed, and the two mandibles so curved and deflected, that when closed they cross each other. This extraordinary structure is supposed to afford the species great facility in stripping the scales from the well-protected seeds of the various kinds of pine-trees. The cross-bills are few in number, and occur both in Europe and America. Their habits as breeding birds are little known, but the period of incubation must be very early, as *L. curvirostra* sometimes visits this country in small flocks as early as June. Temminck says, somewhat vaguely, in regard to the parrot-billed species (*L. pytiopsittacus*), that it "niche en hiver dans nos climats, sur les branches de sapin; en Livonie l'espèce niche dès les mois de Mais."

[1] *Ornitologia Toscana*, t. ii. p. 100.

[2] *Ibid.* p. 106.

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The great pine gross-beak (*Loxia enucleator*, Linn., by some regarded as a bullfinch) may be here named as belonging to the genus CORYTHUS of Cuvier. It is a northern species, occurring in the colder regions both of Europe and America. Although Pennant mentions having met with it in the woods of Invercauld in the month of August, we are not aware of its having ever since been seen in Scotland.

In the genus COLIUS, Gmelin, the bill is short, thick, conical, somewhat compressed, both mandibles arched, and of nearly equal length. The feathers of the tail are long and graduated, and the plumage, for the most part fine and silky, is usually ash-coloured. The hind toe can assume a forward direction, almost as in the swifts. (See Plate CCCXCII. fig. 3.) The species are found in India and Africa. Prior to the time of Vaillant, we knew little of their habits. They are now known to be gregarious, endowed with but feeble powers of flight, but almost as skilful as parakeets in climbing. They are not at all addicted to insect food; but their love of fruits, and the tender buds of trees, makes them very injurious wherever land is under horticultural care. They not only dwell together in society, but build their nests in little groups upon the same thorny bush. They are moreover distinguished by a singular custom of sleeping close together, suspended head downwards from the branches. The species here represented (Plate CCCXCII. fig. 2) is *C. leuconotus*, Lath. (*C. erythropus*, Gmel.), supposed to be identical with *C. capensis*, Linn.

The genus BUPHAGA of Brisson has the bill square at the base, and rather gibbous towards the point, which is abbreviated. The species, only two in number, are insectivorous, and have derived the name of beef-eaters from their habit of picking larvæ from the hides of the larger kinds of cattle, thus freeing them from noxious parasites. The South African species (*B. Africana*, Linn.) was observed by Vaillant in the country of the Namuquas in small flocks. He found it shy, and difficult to be approached. The other species referred to this genus is the *B. erythrorhyncha* of Temm., common in the north-eastern countries of Africa, where it follows caravans for the sake of picking insects from the woolly backs of camels, and other beasts of burden. It is singular, that although hitherto unknown in Southern Africa, it should have been received from Madagascar.

In the genus CASSICUS of Cuv. the bill is much more exactly conical, thick at the base, extremely sharp pointed, the commissure forming an angulated line as in the starlings. These are American birds of gregarious habits, which feed both on fruits and insects, and frequently exhibit such surprising skill and ingenuity in the structure of their nests, that an old lady once gravely asked an American Ornithologist whether he did not think they might be taught to darn stockings. In the genus CASSICUS properly so called, the base of the bill ascends upon the forehead, so as to encroach broadly upon the frontlet feathers. Here are contained the largest species. The one we have figured (*C. cristatus*, Plate CCCXCII. fig. 5) is from Cayenne. In the genus ICTERUS the bill is arched, and Insessores. does not extend upon the forehead except by a sharp notch.[1] With the Icteri Cuvier combines the purple grakle, or crow blackbird of America (*Quiscalus versicolor* of Vieillot), between which and the fish-hawk a singular understanding seems to be kept up. The nest of the latter is of large dimensions, often from three to four feet in breadth, and from four to five feet high, composed externally of large sticks or faggots, among the interstices of which several pair of crow blackbirds will construct their nests, while the hawk sits hatching over all. These birds are very injurious to the crops of Indian corn, and sometimes collect in prodigious flocks, descending on the fields like a blackening tempest. They occupy a great extent of territory, being widely spread from Hudson's Bay to within the tropics. They are migratory in the colder districts, and on their first arrival feed on insects as well as seeds.[2] According to Dr Richardson, their first appearance on the plains of the Saskatchewan is very striking. They arrive from their southern winter quarters in the beginning of May, the males and females in separate flocks of from twenty to a hundred, which perch in crowds upon the leafless branches of the trees, their plumage shining with metallic splendour.

The genus XANTHORNUS (*les carouges*) scarcely differs from the preceding, except that the bill is straight. Here Cuvier places many of the American orioles, such as the red-shouldered species (*O. phœniceus*, Linn.). These "red-winged starlings," as Wilson calls them, are generally migratory in the states north of Maryland, but are found during winter in immense flocks along the lower parts of Virginia, both Carolinas, Georgia, and Louisiana, particularly near the sea-coast, and in the vicinity of large fields of rice and corn. "In the months of January and February, while passing through the former of these countries, I was frequently entertained with the aërial evolutions of these great bodies of starlings. Sometimes they appeared driving about like an enormous black cloud carried before the wind, varying its shape every moment; sometimes suddenly rising from the fields around me with a noise like thunder; while the glittering of innumerable wings of the brightest vermilion amid the black cloud they formed, produced on these occasions a very striking and splendid effect. Then descending like a torrent, and covering the branches of some detached grove, or clump of trees, the whole congregated multitude commenced one general concert or chorus, that I have plainly distinguished at the distance of more than two miles; and when listened to at the intermediate space of about a quarter of a mile, with a slight breeze of wind to swell and soften the flow of its cadences, was to me grand, and even sublime. The whole season of winter, that with most birds is past struggling to sustain life in silent melancholy, is with the red-wings one continued carnival. The profuse gleanings of the old rice, corn, and buck-wheat fields, supply them with abundant food, at once ready and nutritious; and the intermediate time is spent either in aërial manœuvres, or in grand vocal performances, as if solicitous to supply the absence of all the tuneful summer tribes, and to cheer the dejected face of nature with their whole combined powers of harmony."[3]

In this genus some have also placed the noted cow-pen bird of Catesby (*Icterus pecoris*, Bon.; *Emb. pecoris*, Wilson), of which the most remarkable feature consists in its

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[1] For a detailed classification of the Icteri of Brisson, see Mr Vigors's "Sketches in Ornithology," *Zoological Journal*, No. vi. p. 182.

[2] Great confusion exists in the nomenclature of these birds, and of their congeners the troupials, hang-nest orioles, and other American species, chiefly in consequence of the transposition of names. Almost every author has composed his groups of different materials, and of course has applied his designations differently. The genus *Quiscalus* of Vieillot contains four well-ascertained species, *Q. major*, *versicolor*, *ferrugineus*, and *baritus*.

[3] *American Ornithology*, vol. i. p. 193.

depositing, like our European cuckoo, its eggs in the nests of other birds. The circumstances by which Wilson first became acquainted with this peculiar habit are as follows. He had in numerous instances found in the nests of three or four particular species, one egg much larger and differently marked from those beside it. He at length detected the female of this cow-bunting, as he calls it, in the act, that is, sitting in the nest of the red-eyed fly-catcher, (her eyes might well be red, if she had ever fondly hoped for a legitimate posterity), which happens to be a very small one, and singularly constructed. Suspecting her purpose (and truly her position was more than suspicious), he cautiously withdrew without disturbing her, and had the satisfaction to find on his return, that she had left an egg exactly like that just alluded to. He afterwards, in many instances, found the young cow-bunting in the nest of these and of other birds, and also observed the latter followed by a foster child calling most clamorously for food. The cow-bird is gregarious and migratory, entering the middle and northern states about the end of March or beginning of April, and passing northwards as the season becomes milder. It arrives in the fur-countries in May, ranges to the sixtieth parallel, departs in September, and collects in large flocks in Pennsylvania during the following months, after which it retires to winter in the more southern states and Mexico. Its food consists of grain, grass, and worms, particularly certain intestinal ones, which it finds in the dung of cattle. The cow-bunting never pairs, and a state of general concubinage seems to prevail amongst them. Bred up as foundlings in the nests of other birds, and fed by foster parents,—owing their existence and preservation to a system of cunning deception, and commencing their career by the destruction of the natural inmates of that mossy dwelling in which they passed their own delusive infancy,—what hopes can here be cherished of the hallowed growth of home affections? When the female is disposed to lay, she appears restless and dejected, and separates herself from the unregarding males, who care not for posterity. Stealing through the woods and thickets, she pries insidiously into every bush and branch for a nest that suits her fancy, and into it she darts in absence of the owner, and in a few minutes is seen to rise upon the wing, relieved from all maternal care. If the egg be deposited alone, that is, in a previously empty nest, it is almost uniformly forsaken; but if the nursing mother has any of her own she immediately begins to sit. The red-eyed fly-catcher (*Vireo olivaceus*) proves a most assiduous foster-parent. In the beautiful basket-like nest of one of these birds, Mr Nuttall found an egg of each species, and the female fly-catcher already sitting. He removed her own egg, and left that of the stranger. She soon returned, and, as if sensible of what had happened, gazed steadfastly, shifted the egg, sat on it for a time, moved off, renewed her observation, and at length settled down upon her nest. Two or three days after, however, she was found to have left the premises. Yet another bird forsook two eggs of her own, because that of the cow-bird was taken away,—which proves that there is no accounting for tastes. The blue bird, which exhibits a strong attachment to its breeding places, affords one of the few examples of a species not refusing to lay after the stranger's egg has been first deposited. Mr Pickering observed two nests of the blue-eyed yellow warbler, in which, previous to their own laying, an egg of the cow-bird had been deposited, and finding themselves unable to eject it, the warblers buried it in the bottom of the nest, by building over it an additional story! The egg of the cow-bird, perhaps from being larger, and coming thus into closer contact with the body of its nurse, is sooner hatched than the others. The produce of the latter, though often stifled, are sometimes reared along with the intruder. If the natural offspring die, they are found lying at some distance from the nest, and not directly beneath it, which shows that they are carried out by the parents, and not heaved over by the giant intruder, as in the case of our European cuckoo. When fully fledged, the cow-bird soon deserts his foster-parents, and skulks for a time about the woods, till he instinctively joins a few of his own blood, and then he seeks his food more boldly (five or six together), in the fields and lanes.[1] This bird measures about seven inches in length. The head and neck are blackish-brown, the rest black, glossed above with green, and on the breast with violet.

The Baltimore oriole is another beautiful species of Icterus,—*I. Baltimorus*. The male is orange, with the head, neck, upper part of the back, and greater portion of the wings, black. It winters in South America, but makes its appearance in the United States in spring, where its arrival is hailed as the sure harbinger of warmth and sunshine. Full of life and activity, it is seen vaulting like a fiery sylph among the boughs of lofty trees, vanishing with restless inquietude, and again flashing quickly into sight from amidst some wreath of waving foliage, showing like a living gem amid the green adornment of the leafy forest. The most remarkable instinctive feature of this bird is displayed in the structure of its nest, which consists of a pendulous cylindrical pouch of six or seven inches in depth, usually suspended almost from the extremity of some lofty drooping branch. The materials, according to Wilson, are flax, hemp, cow-hair, and wool, woven into a complete cloth, the whole being tightly sewed through and through with long horse-hairs, several of which measure two feet in length. The bottom is composed of thick tufts of cow-hair, also sewed, and strengthened with strong horse-hair. The materials, however, vary, and so solicitous is the bird to procure the best that can be possibly obtained, that during the building season the women in the country are under the necessity of narrowly watching their thread when bleaching.

The genus Oxyrhynchus, Temm., has the conical sharp-pointed bill of the Icteri, but it is shorter than the head. Example, *O. cristatus*, Swainson's *Illustrations*, vol. iii. pl. 49,—a Brazilian species. The genus Dacnis of Cuvier is formed by the *Motacilla cayana* of Linn.

The genus Sturnus, Linn., also resembles the Icteri; but the bill is depressed towards the extremity. There are two European species, one of which, our common starling (*S. vulgaris*), is well known in many parts of Britain, and is remarkable for its gregarious habits, and singular aërial movements. Its glossy black and purple plumage, starred with little spots of white, render it a very ornamental bird; and the great facility with which it may be taught to speak makes it much sought after as a domesticated species. *S. unicolor* inhabits Sardinia and the South of Europe.

Baron Cuvier concludes the conirostral tribe with three well-marked groups, the crows, the rollers, and the birds of paradise.

In the genus Corvus, Linn., the bill is strong, straight, rather long, compressed towards the point, the nostrils covered by stiff, reversed feathers. The plumage, though generally dense and dark, is soft and lustrous, and the species bear so great a resemblance to each other, that, as Mr Macgillivray observes, the most unpractised observer can scarcely fail to distinguish a crow. They also exhibit corresponding instincts, being, if not shy, at least cunning and watchful. They are omnivorous in the fullest sense of the term, and will poke their beaks into every thing

[1] Nuttall, vol. i. p. 178.

Insessores.

they can find, from a boiled potato to a dead horse. "When searching for food, they betake themselves to open places, walk in a sedate manner, keep a good look out, and on the least appearance of danger fly off to a distance. Their flight is also sedate, moderately rapid, and performed by regular beats. Their cry varies from a hoarse croak to a caw or chatter, and some of them are musical. They nestle in high places, trees, towers, buildings of various kinds, or rocks; and produce from three to nine eggs, which are deposited very early in the season. They repose at night in similar places, and when alarmed by day generally take themselves to heights. Some species are gregarious, others unsocial,—the latter being the more carnivorous; but even they are observed to associate together when a large quantity of food attracts them to a particular place. The sexes do not differ much in external appearance; the male, however, being in general more robust, and having the plumage more glossy. Moulting takes place in the summer months, and is very gradual. Those which are more carnivorous have the faculty of discovering carrion at a great distance, in the same manner as the vultures, which they in some degree resemble in their habits. They are all easily tamed, and may be taught to imitate the human voice so far as to produce a few articulate sounds. In a state of domestication they are much addicted to pilfering, their depredations not being confined to articles of food, but extending to objects in no respect useful to themselves."[1]

Five species of crow occur in Britain, all permanent dwellers, viz. the raven (*C. corax*), the carrion-crow (*C. corone*), the hooded crow (*C. cornix*), the rook (*C. frugilegus*), and the jackdaw (*C. monedula*). We shall not describe the external aspect of these birds, which, we doubt not, are familiar to our readers. The raven in a state of nature is remarkable for his great cunning and sagacity, while in the domesticated condition he is extremely frolicsome and full of humour. We have seen one that, while engaged in amusing himself with a poodle dog, and unable to keep pace with his four-footed play-fellow, would seize him by a lock of hair, and hold on tenaciously while the dog was careering at full gallop; and his numerous devices, with a view to conceal the remnants of his own food, or appropriate that of others, were varied and unceasing. This species is widely spread over the temperate and northern parts of Europe and America, and in the minds of the ignorant is usually regarded with some degree of superstitious terror. In summer, when the sky is serene, he flies in circles in the higher regions of the clear blue sky, and his deep and solemn croak may be heard at a great distance; but he is said to be sometimes also seen in the midst of thunder-storms, with the electric fire streaming from the point of his bill!—an extraordinary phenomenon certainly (if true), sufficient to terrify the superstitious, and to stamp its subject with the character of a restless and indestructible demon.

The carrion-crow, and the hooded species, are so like in size and structure, that it would be scarcely possible to distinguish them, but for the partially gray plumage of the latter; and as a black and a gray crow are often seen together, some naturalists incline to the belief that they are actually the same. Their geographical distribution, however, seems to differ; the gray kind, though common in Britain and the continental countries of Europe, being unknown in America, where, at the same time, the carrion-crow is described as identical with our own; while, on the other hand, we find the latter extremely rare in the north of Italy, where the hooded crow abounds. The jackdaw and the rook seem unknown in the western world.

The magpies (genus PICA, Cuv.) are of smaller dimensions than the crows properly so called, and their tails, instead of being either round or square, are long and graduated. Their dispositions, however, are equally omnivorous, and they are distinguished by the same sly and furtive cunning. There is only a single European species, our common British kind (*C. pica*, Linn.), which occurs all over Europe, and is well known in North America, and some parts of Asia. Many beautiful species occur in China, and other eastern countries, such, for example, as the red-billed pie, *P. erythrorhyncha*, Gould. Its size exceeds that of our common kind, and the great length of its tail bestows upon it a still more slender and elegant aspect. The prevailing colours are blue, with bars of black and white. It is often kept in aviaries, where it is highly esteemed, on account both of its docility and beauty. This species likewise inhabits the Himalaya Mountains, and there is reason to believe that it is fierce and tyrannical in a state of nature. Mr Shore states, that one which he kept in captivity, although it refused other food, pounced ferociously upon living birds, which were presented by way of experiment, and eagerly devoured them. When seen amid the foliage of trees, it forms an ornamental and conspicuous object, flitting from bough to bough, its long and flowing tail waving in the wind, and its whole form full of vivacity and grace.[2] The Chinese magpie (*P. sinensis*), made known by the researches of General Hardwicke, seems widely extended over tracts of land of very various character as to height and situation. It inhabits the higher portions of the Himalayas, the plains at the base of those mighty mountains, and a great part of the Chinese empire.

The beautiful jays (genus GARRULUS, Cuv.) are very nearly allied to the magpies, but the tail is not so lengthened, and the culmen of the under mandible is rather more convex. Our British species (*G. garrulus*) is one of the most ornamental of our indigenous birds. It dwells in woods, beyond the outskirts of which it seldom wanders. Its food consists of insects, fruits, and forest seeds. Species of this little group are found in every quarter of the known world except New Holland. The blue jay of America (*G. cristatus*, Plate CCCXCII. fig. 4) is an almost universal inhabitant of the western woods, frequenting the thickest *settlements*, as well as the deepest recesses of the unpeopled forest,—where his harsh voice often alarms the watchful deer, to the mortification of the disappointed huntsman. This species is a bitter enemy to owls, one of which he no sooner discovers than he summons the whole feathered fraternity to his assistance, and the united mob proceed to vent their indignant spite against the blinking solitary, in the most wrathful and unmeasured manner. But this jay himself cannot be held guiltless of the most owl-like depredations,—for he becomes in his turn the very tyrant he detested, and sneaks through wood and thicket, plundering every nest his pokeing bill can reach to, gobbling up the eggs, tearing the callow young to pieces, and spreading not only fear, but death, and sorrow, its sad concomitant, around him. Another very ornamental species—

> Proud of cærulean stains
> From heaven's unsullied arch purloined,

is that mentioned by Pallas as having been shot by Steller when Behring's crew landed upon the coast of America. It is the *Corvus Stelleri* of Latham, by whom it was first described from a specimen in Sir Joseph Banks's collection from Nootka Sound. A larger and most magnificent bird is the Columbia jay (*Garrulus Bullokii*, Wagler,—*G. gubernatrix*, Temm.), figured in Mr Audubon's splendid work. The colour is bright blue, with a lofty crest of separate plumes, the throat and breast black, the abdomen whitish,

[1] Macgillivray's *British Birds*, i. 496.

[2] *Century of Birds from the Himalaya Mountains*, plate xli.

Insessores. and two of the central tail-feathers extending far beyond the others. It occurs chiefly in Mexico and California.[1]

In the genus CARYOCATACTES, Cuv., both mandibles are equally pointed, and straight to the tips. The only species known in Europe, called the nut-cracker (*C. nucifraga*), is an occasional visitant of Great Britain. Two others have of late years been discovered in Asia, one of which is figured by Mr Gould. They are all believed to inhabit forests, especially those of mountainous countries, whence at certain seasons they emigrate in large flocks. In their climbing tendencies they make an approach to the habits of the woodpeckers.

The limited genus TEMIA, Vail., with the lengthened tail and general proportions of the magpies, has the bill elevated, the upper mandible bulged, and its base covered by short velvety feathers. Example, *Corvus varians*, Lath. (*Phenotrix temia*, Horsfield), of which the general plumage is bronzed green, the head black. It occurs in Java and elsewhere.

In the genus GLAUCOPIS, Forster, the bill resembles that of the preceding; but its base bears a pair of fleshy caruncles. *G. cinerea* is the only known species. It is a native of New Zealand, and was discovered during Captain Cook's voyage. Its flesh is excellent. It is the cinereous wattle-bird of Shaw. M. Temminck joins this and the preceding genus into one.

In the genus CORACIAS, Linn., containing the rollers, the bill is strong, compressed towards the point, which is slightly curved, and the nostrils are oblong, not covered by the feathers, but placed at their margin. The feet are short and strong. These birds are confined to the ancient continents, and are remarkable for their beauty of plumage, of which the colours are usually different shades of purple, blue, and green. They are said to be wild and unsociable, feeding on insects, and keeping themselves concealed in the retirement of thick forests. The European species (*Coracias garrula*, Linn.) has been sometimes seen in Britain. The specimen in the Edinburgh Museum was killed at Dunkeld. Although rare in France, it is by no means uncommon in Sweden, where we would not expect to find a species characteristic of the south of Europe, and which is believed to winter in Barbary and Senegal. It is not unfrequent in the gardens of Rome, and is common in the Morea. It becomes very fat in autumn, and is much sought after during that season as an article of food, especially by the inhabitants of the Cyclades. Several other kinds occur in Africa and the East. Of these the Abyssinian species is distinguished by the elongation of the lateral feathers of the tail. The Madagascar roller, and some allied kinds, distinguished by a shorter, more arched, and greatly broader bill, belong to the genus COLARIS, Cuv., synonymous with *Eurystomus* of M. Vieillot.

The genus PARADISEA, Linn., with which we conclude our abridgment of the conirostral tribe, contains the famous birds of paradise, so noted during our early intercourse with eastern countries. The bill is straight, compressed, rather strong, unnotched, the nostrils surrounded by a close tissue of feathers of a velvet texture, sometimes resplendent with metallic lustre. (See Plate CCCXCII. fig. 8.) These birds are native to New Guinea and the neighbouring islands, and in consequence of the delicately graceful structure of their plumage, and the pure and beautifully blended colours by which they are adorned, the species in general may be regarded as the most highly prized of all the feathered race. Their history was long obscure as night, and even now we have but few features of their character developed by the actual observation of trustworthy witnesses. We cannot be here expected to throw any new light upon the subject; but we shall give a portion of the information which we have acquired from various authors.

In the second edition of Pennant's *Indian Zoology*, there is a general description of the genus from Valentyn and other writers, by Dr J. R. Forster, preceded by a learned disquisition on the fabulous phœnix of antiquity, a bird of the size of an eagle, decorated with gold and purple plumes, and more particularly described by Pliny as being characterized by the splendour of gold around the neck, with the rest of the body purple, the tail blue varied with rose-colour, the face adorned with combs or wattles, and the head furnished with a crest. This excellently adorned phœnix Dr Forster very properly supposes to have been no other than a symbolical Egyptian illustration of the annual revolution of the sun, and the conversion of the great year, which, according to Manilius, corresponds with the supposed life of the phœnix, and from which period the same course of seasons and position of the heavenly bodies are renewed. Now, though it is certain, as Dr Forster observes, that the birds of paradise were never known to ancient writers, and that whatever the Egyptian priests delivered concerning their fabulous phœnix has no apparent agreement with the birds in question, yet it is remarkable enough that the names applied to them, both by Indian and European nations, attribute something of a supposed celestial origin. Dr Shaw, however, thinks that this notion has in all probability arisen merely from their transcendent beauty, and the singular and delicate disposition of their plumage. The Portuguese who navigated to the Indian islands called them *Passaros da Sol*, in like manner as the Egyptians regarded their imaginary bird as symbolizing the annual revolution of that great luminary. The inhabitants of the island of Ternate call them Manuco-Dewata, or the Birds of God.[2]

The great bird of paradise (*Paradisea apoda*, Linn., so called from its supposed want of legs), the first of the genus made known to Europeans, was imported about the year 1522, by Antony Pigafetta, who accompanied Magellan in his voyage round the world. Pigafetta was satisfied by ocular demonstration from the first, that this bird, like every other, was supplied with legs, but that the natives cut them off, as parts of no importance. In consequence, however, of this prevailing if not universal mutilation, a notion soon obtained in Europe that the bird was naturally destitute of these common-place but useful organs, and that consequently it floated for ever in the air, winnowing with loving wings the gentle breezes, or at times suspending itself for a few brief moments from some lofty sun-illumined tree, by the two peculiar lengthened filaments with which it is adorned. In accordance with this belief, it was of course consistent to suppose, that whatever individuals were obtained "on this dim spot which men call earth," had fallen from their aërial heights immediately before their dissolution. Even Aldrovandus, the most zealous naturalist of his age, having himself seen only such specimens as had been mutilated in the usual manner, accuses Pigafetta of audacious falsehood in asserting that the bird was naturally furnished both with legs and feet; and the great Scaliger, himself a naturalist of no mean order, gave equal credit to this foolish fancy.

The true residence or breeding-place of these birds seems to be Papua or New Guinea, from whence they make occasional excursions to some smaller neighbouring islands. They fly in flocks of about thirty or forty, led, it is alleged, by a single bird which the natives call their king, but which is said to be of a different species. It is further pretended, that when this bird settles, the whole flight settle also, in consequence of which they sometimes

[1] *The Birds of America*, plate xcvi.

[2] Shaw's *General Zoology*, vol. vii. p. 479.

Insessores. perish, being unable to rise again owing to the peculiar structure of their wings. They also always fly against the wind, lest their flowing plumage should be discomposed. While flying they make a noise like starlings, but their common cry rather resembles that of a raven, and is very audible in windy weather, when they dread the chance of being thrown upon the ground. In the Aru Islands they are seen to perch on lofty trees, and are variously captured by the inhabitants, with bird-lime, snares, and blunted arrows. Though many are taken alive, they are always killed immediately, embowelled, the feet cut off, the plumed skins fumigated with sulphur, and then dried for sale. The Dutch ships frequenting the sea between New Guinea and Aru, a distance of about twenty miles, not unfrequently observe flocks of paradise birds crossing from one to the other of these places, but constantly against the wind. Should a gale arise, they ascend to a great height, into the regions of perpetual calm, and there pursue their journey. With respect to their food we have little certain information from the older authors, some of whom assert they prey on small birds, a supposition which Dr Shaw inclines to think is favoured by their strength of bill and legs, and the vigour with which they act in self-defence. They are also said to feed on fruits and berries; and Linnæus says they devour the larger butterflies.[1]

We owe the following observations to M. Gaimard, one of the naturalists who accompanied the expedition of Captain Freycinet, and who having had an opportunity of seeing several living birds of paradise in the island of Waigiou, has furnished us with some interesting details. He says that they appear to prefer to all other places the most dense and secluded portions of the forests. When the heavens are clear, they perch habitually on the summits of the tallest trees. They fly with rapidity, but in an undulating manner, as is usual with birds which are adorned with long decomposed or disunited feathers; and he confirms the old account, that the luxuriant length of their superb plumage induces them always to fly in the direction from which the wind proceeds. "Cette manœuvre," he observes, "est pour eux très-naturelle, puisqu'elle maintient les longues plumes appliquées contre le corps; dans une direction contraire, le vent ne manquerait pas d'étaler et de relever ces plumes, et il en résulterait nécessairement un grand embarras dans le jeu des ailes." Their total disappearance on the approach of any storm or tempest shows their conscious weakness. In other respects, however, they are courageous, and even vindictive, pursuing fiercely any supposed enemy, however superior to themselves in strength of bill and talons. There is no instance, Captain Freycinet supposes (we now know he does so erroneously), of their being ever reduced to the domestic state; and they are never found caged by any natives of the Papous, where they are by no means rare, and where their skins form the principal object of commercial exchange between the insular inhabitants and the Chinese Indians or eastern Europeans. Authors (we speak not of those who assert that birds of paradise are nourished by dew, or by the perfume which exhales from fruits and flowers) have assigned different diets to these birds. Some say that they search for fruits and nectarous juices; others that they capture insects, and such small prey. There is truth in both statements, for it seems ascertained that they feed alike on fruits and insects. As to all those anxious interesting cares which precede, accompany, or follow incubation,—these and many other important particulars in their history are still unknown. The natives of New Guinea, in preparing the skins, content themselves by removing the fleshy mass of the body, and cutting off the two wings and legs. They then pass a piece of stick through the mouth downwards to the tail. Few of the museums of Europe contain any other specimens than these mutilated remains, which the gorgeous flowing feathers of the sides render still worthy of admiration, however unfit to convey a true idea of the natural state.

We shall next extract some interesting information from a work by M. Lesson, one of the few European naturalists who have had an opportunity of beholding these extraordinary creatures in their native haunts. "Les paradisiers ou du moins l'émeraude, seule espèce sur laquelle nous possédons des renseignemens authentiques, vivent en bandes dans les vastes forêts du pays des Papous, group d'îles situées sous l'équateur, et qui se compose des îles Arou, de Waigiou, et de la grande terre nommée Nouvelle-Guinée. Ces sont des oiseaux de passage qui changent de district suivant les moussons. Les femelles se réunissent en troupes, s'assemblent sur les sommités des plus grands arbres des forêts, crient toutes à la fois pour appeler les mâles. Ceux-ci sont toujours solitaires au milieu d'une quinzaine de femelles qui composent leur sérail, à la manière des gallinacées.

"J'extrairai de mon journal inédit les détails suivans, relatifs aux oiseaux de paradis: ils ont été écrits sur les lieux. *Journal Ms.*, t. vi. p. 19 et suiv. Les *oiseaux de paradis*, à l'exception de deux espèces, nous étaient apportés par les Papous, ce qui établit entre eux et nous un commerce actif d'échange. Je me procurai l'émeraude, le manucode, le loriot paradis orangé, le sifilet, le superbe, les épimaques proméfils, et à paremens frisés, le magnifique, et le rouge. La quantité que les naturels de ces contrées apportaient à bord de la corvette la *Coquille* doit faire supposer que ces oiseaux, si estimés en Europe, y sont singulièrement multipliés. Le manucode se présenta deux fois dans nos chasses, et nous tuâmes le mâle et la femelle. Cette espèce paraît monogame, ou peut-être n'est elle isolée par paires qu'au moment de la ponte. Dans les bois cet oiseau n'a point d'éclat; son plumage rouge de feu ne le décèle point, et sa femelle n'a que des teintes ternes. Il aime à se tenir sur les arbres de teck, dont le large feuillage l'abrite, et dont le petit fruit forme sa nourriture. Il a l'iris brun, et les pieds d'un bleu d'azur très tendre. Les Papous le nomment *saya*. Dès les premiers jours de notre arrivée sur cette terre de promission (la Nouvelle-Guinée) pour le naturaliste, je fus à la chasse. A peine avais-je fait quelques centaines de pas dans ces vieilles forêts, filles du temps, dont la sombre profondeur est peut-être le plus magnifique et le plus pompeux spectacle que j'aie jamais vu, qu'un oiseau de paradis frappa mes regards; il volait avec grâce et par ondulations; les plumes de ses flancs formaient un panache gracieux et aérien, qui, sans hyperbole, ne ressemblait pas mal à un brillant météore. Surpris, émerveillé, éprouvant une jouissance inexprimable, je dévorais des yeux ce magnifique oiseau; mais mon trouble fut si grand que j'oubliai de le tirer, et que je ne m'aperçus que j'avais un fusil que lorsqu'il était déjà bien loin. On ne pourrait guère avoir une idée exacte des paradis d'après les peaux que les Papous vendent aux Malais, et qui nous parviennent en Europe. Ces peuples chassèrent primitivement ces oiseaux pour décorer les turbans de leur chefs. Ils les nomment *mambéfore* dans leur langue, et les tuent pendant la nuit, en grimpant le long des arbres où ils se couchent, et les tirant avec des flèches faites exprès et très courtes, qu'ils façonnent avec le rachis des feuilles d'un latanier. Les campongs ou villages de *Mappia* et d'*Emberbakène* sont célèbres par la quantité des oiseaux qu'ils préparent, et tout l'art des habitans se borne à leur arracher les pieds, à les écorcher, à leur fourrer un bâtonnet à travers du corps, et à les dessécher à la fumée. Quelques uns plus adroits, et sollicités par les trafiquans

[1] Shaw's *General Zoology*, vol. vii. p. 482–4.

Chinois, les desséchent avec les pieds. Le prix d'un oiseau de paradis chez les Papons de la côte est au moins d'une piastre, et ces peuples préfèrent l'argent à tout autre objet, même à du fer travaillé.

"Nous tuâmes, pendant notre séjour à la Nouvelle-Guinée, une vingtaine de ces oiseaux, que je préparai pour la plupart. Ils appartenaient à diverses personnes de l'expédition, et notamment au capitaine. Je n'en avais point encore, lorsque M. Bérard, lieutenant de vaisseau, zélé pour les collections que je formais en simple particulier, et à mes frais, pour le Muséum, et pour remplir la promesse que j'avais faite au ministère, en m'embarquant, de recueillir les objets d'histoire naturelle, voulut bien m'en remettre un pour la collection. Depuis, j'en achetai un second d'un homme de l'équipage, que je lui payai 150 francs. J'en tuai ensuite un avec un grand nombre de femelles: on les voit au Muséum.

"L'éméraude en vie est de la taille du geai de France; son bec et ses pieds sont bleuâtres; l'iris est d'un jaune éclatant; ses mouvemens sont vifs et agiles; il ne se perche communément que sur le sommet des plus grands arbres. Lorsqu'il en descend, c'est pour manger les fruits de quelques arbres moyens, ou lorsque le soleil, dans toute sa force, lui fait un besoin de chercher de l'ombrage. Il affectionne certains arbres, et fait retentir les environs de sa voix perçante. Son cri lui devint fatal, parce qu'il nous indiqua les allures de cet oiseau. Nous l'épiâmes, et c'est ainsi que nous parvîmes à en tuer; car, lorsqu'un paradisier mâle est perché, et qu'il entend bruiser dans le silence de la forêt, il se tait et ne bouge plus. Son cri d'appel est un *voike, voike, voike, voiko*, fortement articulé. La femelle a le même cri, mais elle le pousse d'une manière bien plus faible. Celle-ci, déchue du brillant plumage de son époux n'a que de sombres atours. Nous en rencontrions à chaque arbre des vingtaines réunies, tandis que les mâles, toujours solitaires, n'apparaissaient que rarement.

"C'est au lever du soleil et à son coucher que l'oiseau de paradis va chercher sa nourriture. Dans le milieu du jour, il se tient caché sous le large feuillage du teck, et n'en sort point. Il semble redouter l'action des rayons brûlans de cet astre, et ne point vouloir s'exposer aux atteintes d'un rival. Nous apprîmes, par une longue expérience, à imiter la ruse de ce bel oiseau; mais le zéle des tueurs de paradisiers était si grand que personne ne voulait tirer sur aucun autre oiseau de peur de les effaroucher, et que, réduit à peu près à mes seules ressources, le tribut que quelques personnes me donnaient de leur chasse fut bien diminué; plus curieux, dans l'intérêt de la science, d'un petit volatile inédit, que de posséder plus ou moins de dépouilles d'une espèce connue, bien que prisée, je ne guettai des paradis que pendant quelques jours, et tuai d'ailleurs toute espèce qui arrivait à ma portée.

"Pour chasser les oiseaux de paradis, les voyageurs appelés à visiter la Nouvelle-Guinée doivent se rappeler qu'il est nécessaire de partir dès le matin du navire, d'arriver au pied de l'arbre de teck ou du figuier, que ces oiseaux recherchent à cause de leur fruit (notre séjour a eu lieu du 26 Juillet au 9 Août), avant quatre heures et demie du matin, et de rester immobile jusqu'à que quelques mâles, pressés par la faim, viennent sur les branches qu'on aura jugé à distance convenable. Il est indispensable de posséder un fusil à très longue portée, et chargé à gros plombs, car il est fort difficile de tuer roide un *éméraude*, et s'il n'est que blessé, il est bien rare qu'il ne soit pas perdu pour le chasseur, dans des fourrées tellement épaisses, qu'on ne peut y reconnaitre son chemin sans une boussole.

"Le paradisier petit éméraude mange sans doute de plusieurs substances dans son état de liberté. Je puis affirmer qu'il vit de graines de teck, et d'un fruit nommé *amihou*, blanc rosé, de saveur fade et mucilagineuse, de la grosseur d'une petite figue d'Europe, et qui appartient à un arbre du genre *ficus*. Ces fruits plaisent à beaucoup d'oiseaux, car ils sont aussi recherchés par les *calaos*, les *manucodes*, et les *cassicans calibé* et *phonygame*.

"J'ai vu deux oiseaux de paradis conservés dans une cage, depuis plus de six mois, par le chef des commerçans Chinois, à Amboine. Ils étaient toujours en mouvement, et on les nourrissait avec du riz bouilli; mais ils aimaient surtout les cancrelas (*blatta*). Ce Chinois me les fit 500 francs pièce; alors, sans argent, et n'ayant point de crédit dans cette île, je ne pus réclamer ma solde, et ce fut en vain que j'offris des objets de valeur à ce trafiquant opulent, il fut sourd à mes prières. Pourquoi, sur l'argent que nous possédions à bord, pour frais accidentels, et qu'on a retourné à Paris, ne pas avoir acheté, pour le destiner à la France, un de ces magnifiques oiseaux, qui serait peut-être mort en route, mais dont les habitudes vivaces, et analogues à celles de nos pies, nous donnaient tant de chances de succès?"[1]

We shall conclude our miscellaneous extracts in illustration of these birds, by a quotation from a recent English writer. The principal object of attraction to strangers at Macao is known to be the splendid aviary and gardens of Mr Beale, who, after a residence of forty years in that country, devotes his leisure to the cultivation of many of the most delightful productions of nature, and among these not the least remarkable is the living bird of paradise, as thus described by Mr Bennet. "The specimen in the possession of Mr Beale is a fine male, *Paradisea apoda* of Linnæus, the *P. major* of Shaw. He was at the time I beheld him arrayed in his full and splendid plumage; he is enclosed in a large and roomy cage, so as not by confinement to injure in the slightest degree his delicate and elegant feathers. This beautiful creature has been in Mr Beale's possession nine years, and was originally procured from the island of Bouro (one of the Molucca group), which is situated in about latitude 3° 30′ south, and longitude 126° 30′ east.... The neck of this bird is of a beautiful and delicate canary-yellow colour, blending gradually into the fine chocolate colour of the other parts of the body; the wings are very short, and of a chocolate colour. Underneath them, long, delicate, and gold-coloured feathers proceed from the sides in two beautiful and graceful tufts, extending far beyond the tail, which is also short, of a chocolate colour, with two very long shafts of the same hue proceeding from the uripigium. At the base of the mandibles the delicate plumage has during one time (according as the rays of light are thrown upon it) the appearance of fine black velvet, and at another a very dark green, which contrasts admirably with the bright emerald of the throat.... The mandibles are of a light blue, irides bright yellow, and the feet of a lilac tint. This elegant creature has a light, playful, and graceful manner, with an arch and impudent look; dances about when a visitor approaches the cage, and seems delighted at being made an object of admiration; its notes are very peculiar, resembling the cawing of the raven, but its tones are by far more varied. During four months of the year, from May to August, it moults. It washes itself regularly twice daily, and after having performed its ablutions, throws its delicate feathers up nearly over the head, the quills of which feathers have a peculiar structure, so as to enable the bird to effect this object. Its food, during confinement, is boiled rice mixed up with soft egg, together with plantains, and living insects of the grasshopper tribe; these insects, when thrown to him,

[1] *Manuel d'Ornithologie*, t. i. p. 387.

the bird contrives to catch in his beak with great celerity; it will eat insects in a living state, but will not touch them when dead.

"I observed the bird, previously to eating a grasshopper given him in an entire or unmutilated state, place the insect upon the perch, keep it firmly fixed with the claws, and divesting it of the legs, wings, &c. devour it, with the head always placed first.....It rarely alights upon the ground, and so proud is this creature of its elegant dress, that it never permits a soil to remain on it; and it may be frequently seen spreading out its wings and feathers, and regarding its splendid self in every direction, to observe whether it is in an unsullied condition."[1]

Dr Shaw alludes to an instance of the bird of paradise having been brought alive to England. It had, however, entirely lost the beautiful floating feathers which render its body apparently so light and buoyant, and did not long survive its arrival in our murky clime.

Although there are not above seven distinct species of these birds, they have been formed into no less than four separate genera by M. Vieillot. The most anciently known is the kind called in English books the great or common bird of paradise, *l'émeraude* of the French, *P. apoda*, Linn. to which most of the preceding memoranda may apply. (See Plate CCCXCII. fig. 6.) It is of a cinnamon colour, the upper part of the head and neck yellow, the front and throat emerald green, or black. It is the male of this species which bears the long, floating, yellow plumes so prized as articles of commerce, with a view to ornament in dress. Although the body is no larger than that of a thrush, the total length is two feet. In the red paradise bird (*P. rubra*) the head and throat are emerald-green, the back and front of the neck orange yellow and velvety, the throat chesnut or cinnamon colour, and the long feathers of the flanks brilliant carmine red. The two peculiar barbless shafts which proceed from the base of the tail, are broad, flattened, twisted, and of a brownish-red colour. These belong to the restricted genus Paradisea.

The six-shafted paradise bird (*P. sexsetacea*, Shaw,—*P. aurea*, Gmel.) is black, with the throat of golden green, and three prolonged setaceous feathers proceeding from behind each eye, and terminating in a little expanded disk of golden green. It forms the genus Parotia of Vieillot. We shall merely add, that *P. superba* constitutes the genus Lophorina,—*P. regia* that called Cicinnurus,—and *P. nigra*, Gmel., another named Astrapia. The whole are figured by Buffon, Vaillant, or Vieillot, and their singular forms, gorgeous colouring, and exquisite structure of plumage, render them deserving of the most attentive consideration on the part of all admirers of nature.

Tribe 4th.—Tenuirostres.

Baron Cuvier here places a variety of generic groups which agree chiefly in possessing a slender lengthened bill, sometimes straight, sometimes considerably curved. According to the structure of the tongue, which in several genera is not yet distinctly known, they feed either on insects or the nectarous juices of fruits and flowers,—a few, such as the humming-birds, combining both these habits.

In the genus Sitta the bill is straight, pointed, compressed at the extremity, and the tongue short and corneous. The species called *nut-hatches* climb along the bark of trees with extraordinary facility, not only upwards, like the woodpeckers, but downwards, and in all directions. The European species (*S. Europea*), though a constant resident in Britain, is rather rare in most localities. It breeds in hollow trees, not seldom using the deserted habitation of a woodpecker, the opening into which it contracts by means of a wall of clay. The female sits very close during incubation, and instead of flying off when approached, she will utter a hissing sound, and make a show of striking at the intruder with her bill and wings. Sir W. Jardine some time ago enjoyed an opportunity of observing a brood which had been taken young. They became remarkably tame, and when released from their cage, would run over their owner in all directions, poking into seams and pockets, as if in search of food upon some goodly tree, and uttering from time to time a low and plaintive cry. In climbing, they rest much upon the tarsus, but never use the tail. Several true nut-hatches occur in North America, but Pennant erred in supposing that the European species was likewise indigenous to the new world.

In the genus Xenops of Illiger, the bill is rather more compressed, and the under ridge more convex, while in Anabates of Temm. it is the upper ridge which increases in convexity, so as to approach to that of the thrushes; but the tail in some of the species is long and wedge-shaped, and exhibits a worn appearance, as if it were occasionally used in climbing.

In the genus Synallaxis, Vieil., the bill is straight, not much lengthened, considerably compressed, slender and pointed, and the tail is generally long and acuminate. (See Plate CCCXCII. fig. 7.) We know little of the habits of these birds, except that they are insectivorous, and dwell in forests. Most of the species are from South America, and to these it is probable that the generic term should be restricted.

The old genus Certhia of Linnæus was characterized by an arched bill, but the species possessed but little else in common, and have been therefore formed into several minor groups. The true or restricted creepers (Certhia, Cuv.), so called from their habit of running round the trunks of trees, have the bill of medium length, curved, compressed, slender, sharp pointed. The tail is wedge-shaped, and composed of stiff, deflected feathers. Our well-known British species (*C. familiaris*) is the only example of the genus found in Europe, and it is in fact doubtful whether there is any other elsewhere. The North American creeper seems identical, but the numerous other birds described as creepers do not belong to the genus Certhia. The solitary type alluded to is a retired inhabitant of the woods, in no way conspicuous in colour, though pleasingly mottled above with black, brown, and grayish white; and being of small size, and seldom showing itself in open places, is deemed rarer than it really is. Though of a somewhat lengthened form, it is probably, with the exception of the golden-crested wren, the smallest bodied British bird. It is said to feed entirely upon insects, although as a winter resident in many frost-bound regions, we shall not aver that it never swallows seeds. It builds in the hollows of trees, and may be often seen during the delightful autumn, when the rustling woods are fragrant with fallen leaves, flitting from the top of one trunk to the bottom of another, which it ascends by a kind of spiral progression, and then darting downwards to a neighbouring tree, it thus busily pursues from time to time its interrupted flight. This bird chiefly shows itself in our shrubberies and wooded pleasure-grounds in winter.

In the genus Dendrocolaptes, Hermann, the tail resembles that of the preceding, but the bill is much stronger, and enlarged at the base. In certain species it is greatly curved. (Plate CCCXCII. fig. 9.) These birds are American, and are usually characterized by a reddish plumage. In Tichodroma, Illiger, the tail does not present a worn appearance at the point, although the best known, if not the only species, runs up rocks with great agility. The bill is long, slender, triangular, and depressed at the base.

[1] *Wanderings in New South Wales*, &c. vol. ii.

The European species, called by us the wall-creeper (*T. phœnicoptera*, Temm.,—*Certhia muraria*, Gmel.), inhabits the southern countries of Europe, where it dwells among lofty and precipitous rocks. It is well known among the Swiss Alps, and the mountainous parts of Spain and Italy, where it is said to prey much on spiders and their eggs.

In the genus Nectarinia of Illiger, the bill is arched, pointed, and compressed, resembling that of the creepers, with which the species were so long conjoined; but they do not climb, and their habits, if the name is properly applied, are not so much insectivorous as honey-sucking. They are all exotic. The term *guit-guit* is given by the French to certain small species, of which the plumage of the males is very rich and lustrous. Their tongue is bifid and filamentary. Such are *Certhia cyanea*, *cerulea*, &c. Some species of larger size and less adorned plumage, and of which the tongue is short and cartilaginous, have been separated from the others. Such is a South American species, the *Merops rufus* of Gmelin, as large as a nightingale, of a reddish colour above, the throat whitish. It constructs a covered nest, and serves as the type of Temminck's genus Opetiorhynchus.[1]

The genus Dicæum of Cuv. has the bill longer than the head, sharp, curved, depressed, and broadened at the base. The species are of small size, and usually ornamented with portions of scarlet. They are natives of the East Indies. In Melithreptus of Vieillot, the bill is extremely long, and curved almost into a semicircle. Of this form the hook-billed creeper, *Certhia vestiaria*, Shaw, affords a good example. (Plate CCCXCIII. fig. 2.) It is a native of the Sandwich Islands, where it is much valued on account of its plumage, which affords the principal material in the formation of those gorgeous scarlet mantles worn by chiefs and persons of distinction.

The *souimangas* (a Madagascar name, signifying sugar eaters, genus Cinnyris, Cuv.) have the bill long, slender, and finely toothed along the edges. The tongue is capable of considerable extension, and terminates in a small bifurcation. The species are widely dispersed over all the southern regions of the old world (Africa, the Indian Archipelago, &c.), and seem in those countries to represent the beautiful humming-birds of the western world. Indeed these tribes greatly resemble each other both in form and habits. The souimangas are subject to a double moult, which occasions a considerable diversity in the plumage even of the same species, according to the season of the year; and hence our knowledge of this, as of several other sumptuous groups, though sufficiently voluminous, is probably not yet remarkable for its accuracy. Several splendid works, however, have been devoted, either in whole or in part, to its illustration.[2] The nuptial plumage is remarkable for its golden lustre, and the richness and variety of its innumerable iridescent hues; but after the termination of the breeding season, a much more humble garb is assumed, and many a *bizarre* appearance is presented by the intermediate links of that changeable costume which connects the holiday-suit of spring with the more quaker-like attire of autumn. Hence the difficulty of distinguishing in many birds, between a specific difference and an individual variation, more especially where foreign species are concerned; for in such instances we have seldom a prolonged opportunity of verifying our observations on external characters, by an examination of natural habits and instinctive modes of life. Yet it is only by ascertaining the uniformity presented by all these circumstances in a variety of individuals, that we are enabled to trace out the exact limits of specific identity. Several species of Cinnyris occur in India, but the greater proportion are of African origin, and may be said to form the most signal and admired feature in the Ornithology of that country.

In the greater number the tail is equal. Of these we may name the superb creeper (*C. superba*), described and figured in the magificent work of M. Vieillot. Its length is six inches; the crown of the head, upper part of the neck, smaller wing-coverts, back, and rump, are bright-greenish gold; across the upper part of the breast runs a bar of bright gilded yellow, beneath which the whole under parts are deep brownish crimson; the wings and tail are blackish brown, the legs are also brown, the bill is black. This beautiful species was discovered at Malimba, in Africa, by M. Perrein. Another highly adorned species, such "as limners love to paint, and ladies to look upon," is the *Certhia splendida* of Shaw (*C. afra* and *lotenia*, Linn.?). It usually occurs in woody places, and, in addition to its splendid plumage, is said to be worthy of admiration for its musical powers,—its song being by some esteemed equal to that of the nightingale. The spotted breasted Cinnyris (*C. maculata*) also dwells in the forests of Malimba, and frequently approaches the habitations of the natives, allured by the flowers of the Cytisus cajan, commonly called the congo pea, which, according to Dr Shaw, is much cultivated by the negroes.

In some of these birds the central feathers of the tail are lengthened in the males. Such is *C. violacea*, a Cape species, which likewise dwells in woods, and is said to build a nest of a singularly elegant construction. In a few the bill is almost straight, as in *C. rectirostris*, Vieillot. Our restricted limits will not admit of our expatiating on this delightful group.

The genus Arachnothera of Temm. has the long arcuated bill of the souimangas, but it is of stronger structure, and wants the dentations, and the tongue is short and cartilaginous. The species (such as *A. longirostra* and *inornata*, Temm. *Pl. Col.* 84, figs. 1 and 2), so far as yet known, inhabit the Indian islands, and prey on spiders.

The genus Trochilus, Linn., contains the true humming-birds, a numerous group of fairy and fantastic forms, which inhabit both continents of America, and some neighbouring islands, but are altogether unknown in the ancient world. The bill is long and slender, but in its range throughout the entire species exhibits considerable modification, being in some nearly straight, in others curved, and in a few turned upwards. Such as are characterized by an almost straight bill constitute the genus Ornismya, Lesson (*Orthorhynchus*, Lacepede), Plate CCCXCIII. fig. 1; while those in which it is more or less bent remain under the ancient name of Trochilus, *Ibid.* fig. 6. The tongue is long and extensile, and is usually described as being composed of two muscular tubes united for the greater part of their length, and broadening towards the point into a spoon-like portion. Sir W. Jardine, on relaxing a specimen of *T. moschitus*, observed the appearance of a fimbriated opening at the tip, the outer margin of each division being beset with recurved, sharp-pointed, pliable spines, while in all that Mr Swainson examined the two filaments were perfectly flat. Their feet are extremely small, their wings long and narrow, their tails comparatively broad,—whilst their shortened humerus and very large unnotched

[1] The generic name of *Nectarinia* was bestowed by Illiger upon those foreign creepers known by the terms *guit-guits* and *souimangas*, but it has been applied more exclusively by Cuvier to the former, and by Temminck to the latter. The souimangas, on the other hand, fall into Cuvier's genus *Cinnyris*, while the guit-guits are placed in the genus *Cœreba* by Temm. These transpositions, as we have already remarked, are extremely perplexing.

[2] Vaillant, *Hist. Nat. des Oiseaux d'Afrique*, 5 vols. in 4to, 1799, and subsequent years,—and Audebert, *Oiseaux dorès, ou à reflets métalliques*, 2 vols. fol. Paris, 1802. A continuation of the latter work has been published by M. Vieillot.

Insessores. sternum exhibit osteological features in relation to the power of flight resembling those of swifts. The beauty of their plumage, if equalled, is certainly unsurpassed among the feathered tribes.

Humming-birds, in general, may be said to inhabit chiefly the intra-tropical regions of America, including the West Indies; but that they are capable of sustaining a considerable reduction of temperature, and of spreading themselves into comparatively rigorous climes, is evident from the observations of Captain King, who in his survey of the southern coasts met with numerous examples of these diminutive creatures flying about in a snow-storm near the Straits of Magellan, and discovered two species in the remote island of Juan Fernandez. Two other hardy species had been long known to migrate during summer far into the interior of North America, viz. the ruff-necked humming-bird (*T. rufus*), discovered during Cook's voyage in Nootka Sound, and since traced by Kotzebue to the 61st degree of north latitude, along the western shores; and the ruby-throated humming-bird (*T. colubris*), which was found breeding by Mr Drummond near the sources of the Elk River, and is known to reach at least as far north as the fifty-seventh parallel. Mr Bullock also discovered several species at a high elevation, and of course a coolish temperature, on the lofty table-lands of Mexico, and in woods in the vicinity of the snowy mountains of Orizaba. The best and most ample history of these "feathered gems" may be gathered from the pages of Wilson and Audubon, while the superb adornment of their beautifully pencilled plumage, so rich in its varied combination of lustrous green and gold, may be studied with advantage in the sumptuous pages of M. Lesson.[1] They are of a most lively and active disposition, almost perpetually upon the wing, and darting from flower to flower with the busy rapidity rather of a bee than a bird. In the uncultivated districts of the country they inhabit the forests, but in peopled regions they flock without fear into the gardens, poising themselves in the air, while they thrust their long extensile tongues into every flower in search of food. According to Bullock, they will remain suspended in a space so small that they have scarcely room to move their wings, and the humming noise which they produce proceeds entirely from the prodigious velocity with which they vibrate these tiny organs, by means of which they will remain in the air almost motionless for hours together. An older writer, Fermin, a physician of Surinam, compares this action to that of the bee-like flies which in still and sultry weather we often see hovering in the vicinity of still waters; and Wilson says, that when a humming-bird arrives before a thicket of trumpet-flowers in bloom, he suspends himself so steadily that his wings become "invisible, or like a mist." They often enter windows, and after examining any fresh bouquets with which fair hands may have decked the table, they will dart like sun-beams out by an opposite door or window. During the breeding season they become jealous of encroachment, and exhibit great boldness in defence of their supposed rights. When any one approaches their nest, they will dart around with a humming noise, frequently passing within a few inches of the intruder's head. A small species called the Mexican star (*T. cyanopogon*) is described by Mr Bullock as exhibiting great intrepidity while under the influence of anger. It will attack the eyes of the larger birds, striking at them with its sharp, needle-like bill; and when invaded by one of its own kind during the breeding season, their mutual wrath becomes immeasurable, their throats swell, their crests, tails, and wings expand, and they fight in the air till one or other falls exhausted to the ground. Indeed old Fernando Oviedo gives a still more alarming statement of their fiery temper. "When they see a man climb y^e tree where they have their nests, they flee at his face, and stryke him in the eyes, commying, goying, and returnyng with such swiftness, that no man woulde ryghtly believe it that hath not seen it."[2]

Although humming-birds may frequently suck the juices of flowers, those naturalists err who allege that they support themselves exclusively on that natural nectar. "For myself," says Wilson, "I can speak decisively on the subject: I have seen the humming-bird for half an hour at a time darting at those little groups of insects that dance in the air in a fine summer evening, retiring to an adjoining twig to rest, and renewing the attack with a dexterity that sets all our other fly-catchers at defiance." Mr Bullock thinks it probable that all the species eat insects, and he had repeated ocular proof that many of them feed on flies, which they both caught themselves, and used to *steal* from spiders' webs. It was only the smaller kinds, however, that they dared to molest, for the stronger spiders showed fight, on which the besiegers would shoot off with the rapidity of a sun-beam, and could scarcely be discovered but by the luminous glow of their refulgent colours. It may easily be conceived that creatures of such resplendent plumage, in spite of their irascible temper and pugnacious habits, are universal favourites wherever they appear; and that in "the sweet serenity of a summer morning," their visits to the dewy flower-beds of a cottage dwelling are surely welcomed with delight.

When morning dawns, and the blest sun again
Lifts his red glories from the eastern main,
Then through the woodbines, wet with glittering dews,
The flower-fed humming-bird his round pursues;
Sips with inserted bill the honey'd blooms,
And chirps his gratitude as round he roams;
While richest roses, though in crimson drest,
Shrink from the splendour of his gorgeous breast.
What heavenly tints in mingling radiance fly!
Each rapid movement gives a different dye;
Like scales of burnished gold they dazzling show,
Now sink to shade—now like a furnace glow!

In the summer of 1803 a nest of young humming-birds was brought to Alexander Wilson. They were nearly fit to fly; in fact, one of them did fly out of the window the same evening, and falling against a wall, was killed upon the spot. The other refused food, and in consequence of this foolish obstinacy its life next morning was nearly extinct. A lady in the house undertook to be its nurse, and placing it in her bosom, it immediately began to revive, which showed its good taste and natural sense of comfort. She then kindly dissolved a little sugar in her mouth, and thrusting its bill into the same, the creature sucked with great avidity. In this manner it was brought up until fit for the cage. Wilson kept it for three months afterwards, supplying it constantly with loaf-sugar dissolved in water, which it preferred to honey and water. He also gave it fresh flowers every morning, sprinkled with the sugary liquid. It appeared quite gay, active, and full of spirit, hovering from flower to flower as if in its native wilds (alas! it still was caged), and always expressed by its motions and chirping the greatest pleasure at the sight of every fresh supply of flowers. "Numbers of people," says our author, "visited it from motives of curiosity, and I took every precaution to preserve it if possible through the winter. Unfortunately, however, by some means it got at large, and, flying about the room, so injured itself that it soon after died."

Most of the preceding notices apply to the ruby-throated humming-bird (*T. colubris*, Linn.), the species of which

[1] *Histoire Naturelle des Oiseaux Mouches*;—*Hist. Nat. des Colibris*;—*Hist. Nat. des Trochilidés.*

[2] *History of the West Indies*, translated by Richard Eden, p. 199.

Insessores.

the particular habits and general economy have been the most minutely studied. It sometimes makes its appearance in Louisiana as early as the 10th of March, and shows itself some weeks later in the northern states, varying not only with the latitude, but the temperature of each season. Its nest is described by Mr Audubon as being of the most delicate nature, the external parts formed of a light-gray lichen found on the branches of trees, or on decayed fence-rails, and so neatly arranged round the whole nest, as well as to some distance from the spot to which it is attached, as to seem part of the branch or stem. These little pieces of lichen, he and others allege, are glued together with the saliva of the bird; but whether this fact has been proved by observation, or is only a natural inference from the actual appearance of agglutination, we cannot say. The next coating, however, consists of a cottony substance, and the innermost of all of silky fibres obtained from various plants, and extremely soft and delicate. In this delightful little bed the female lays only two eggs, of an almost oval form, and colour of pure white.[1] Not more than ten days are required for hatching; the young are ready to fly in seven or eight days; they are fed or cherished by the parents for nearly another week; and Mr Audubon is of opinion that they are no sooner able to provide for themselves than they associate with other broods, and perform their migrations apart from the old birds, as he has sometimes observed twenty or thirty young humming-birds resorting to a group of trumpet-flowers when not a single adult male was to be seen.[2] The migration of birds, as Dr Richardson has well observed, has in all ages been an object of pleasing speculation to the philosopher; but in no instance does it appear more wonderful than when contemplated in relation to these tiny tribes. The lofty and sustained flight of the eagle and albatross seems only commensurate with their gigantic size, and the irresistible sweeping of their mighty pinions; "but how is our admiration of the ways of Providence increased, when we find that one of the least of its class, clothed in the most delicate and brilliant plumage, and apparently more fitted to flutter about in a conservatory than to brave the fury of the blast, should yield to few birds in the extent of its migrations."[3]

The only instance with which we are acquainted of a humming-bird having been brought alive to England, is that mentioned by Latham. A young gentleman, a few days before sailing from Jamaica, observed a female of *Trochilus mango* sitting on her eggs. He secured the bird, cut off the twig, and brought the whole on board his vessel. The mother was fed with honey and water, and during the voyage hatched two young ones, which survived their parent, were landed in England and lived for some time in the possession of Lady Hammond, from whose mouth they readily sipped nectar. The longest survivor, however, died in about two months after its arrival. These frail creatures are in fact far too impatient of continuous cold to endure the climate of Britain during winter. We shall conclude by observing, that the species are very numerous, and, like the generality of extensive groups, have been of late partitioned into many minor genera by M. Lesson, and others who have devoted themselves to their consideration. The range of size, as well as of character, is considerable,—*Trochilus minimus*, which is no larger than an able-bodied bee, is the least of all the feathered race,—while *Trochilus gigas*, a "triton 'mong the minnows," is the largest of humming-birds, and almost equals the dimensions of a swallow.

In proceeding with our exposition of the tenuirostral tribes, we now approach the *Hoopoes*, in close approximation to which is placed the genus Fregilus of Cuvier, containing only a single European species, the *Corvus graculus*, or red-legged crow of British writers, which we have already briefly noticed as a *Pyrrhocorax*. It is in truth so nearly allied to the Alpine crow (*C. pyrrhocorax*), or *choucard des Alpes*, both in structure and habits, and is so often seen in company with that species, that wherever the one may be placed, the other should not be far distant. M. Temminck, indeed, places them in the same genus, although the bill of the red-legged bird (or Cornish chough) is longer than the head, more subulate and slender at the point, and without any notch. Cuvier regards the *Corvus affinis* of Latham, and another species from New Holland, as both belonging to the genus Fregilus.

The true hoopoes (genus Upupa) are all distinguished by a crest upon the head, composed of a double row of lengthened plumes, and capable of being raised at pleasure. The only European species (*U. epops*, Linn. Plate CCCXCIII. fig. 3) is a summer bird of passage on the Continent, where it travels northward even as far as Sweden. It never breeds in Britain, though it sometimes accidentally occurs there. We had one sent us a few years ago from the county of Fife. This bird is called *bubbola* by the Italians, most probably from its peculiar cry. It keeps itself concealed among the trees; but is constantly heard repeating the syllable *bu, bu, bu, bu, bu*, with such a strong sonorous voice, that it may be heard at a great distance. Its song properly so called is only uttered during the honey-moon. Although the hoopoe lives and builds in woods, it may be often seen, in search of insect food, in fields and pastures. The nest is generally placed either in the natural hollow of a tree, or in the deserted excavation of a woodpecker. It is composed outwardly of feathers, and is lined with the hair of cows and horses. The eggs are grayish white, finely spotted with brown. This bird is very common in Egypt. A nearly allied species (*U. Capensis*) is found at the Cape, and occurs also in the East Indies; but we presume M. Savi is in error when he says the genus is likewise known in America.

The genus Promerops of Brisson has also an elongated slender bill, finely pointed, laterally compressed, somewhat convex above, with the nostrils open and cleft longitudinally. The tail is very long and graduated, and the tongue is extensile and bifurcated, so that the species are able to absorb the nectarous juices of flowers. The title seems now restricted to the African species, of which the only one distinctly known is the Cape promerops (*P. Capensis, Merops caffer*, Gm.), of a grayish brown above, with a white throat, bordered by two dark lines, the breast reddish, the abdomen yellow. The tail is of great length during the completed plumage; but the long, ribbon-like feathers are often absent, which greatly alters the external character of the bird. (See Plate CCCXCIII. fig. 5.)

In the magnificent and somewhat disputed genus Epimachus, Cuv., the bill, though more robust in some of the species, resembles that of the two preceding genera; but the base, or region of the nostrils, is beset with short, rounded, scale-like feathers, after the manner of the birds of paradise, which they somewhat resemble, moreover, in the great extension of certain portions of their plumage. They are also native to the same countries. The *Epimachus magnificus* has the general plumage of a rich velvet black, the head and throat lustrous, with changing tints of green and blue. The tail is of ordinary length and structure, but the sides are singularly ornamented by long extended filamentous feathers. (See Plate CCCXCIII. fig. 7.) The female is much less adorned, being, according to M.

[1] Dr Richardson describes the eggs as of "a reddish white colour, and obtuse at both ends."

[2] *Ornithological Biography*, vol. i. p. 251.

[3] *Fauna Boreali-Americana*, part ii. p. 323.

Insessores. Lesson, reddish above and gray below, streaked with brown. The *Epimachus superbus* is likewise of a velvet black, glossed in various parts with golden green and purple, the flank feathers greatly developed, and terminated by a brilliant edging. The tail is of such enormous length (Plate CCCXCIII. fig. 4) that the total extent of this species is nearly four feet. The female (*Upupa fusca* of Gmelin ?) is described as reddish on the wings and tail, the body of a mingled black and brown. The two preceding kinds inhabit New Guinea. The *Paradisea alba* of the older systems is by some referred to our present genus, which has also been made to contain a beautiful New Holland species, known to the natives by the name of rifle-bird, and described by Mr Swainson under the title of *Ptilorus paradiseus*. It is the *Epim. regius* of Lesson and Garnot,[1] and was previously figured by Mr Wilson as *Epim. Brisbanii*, in honour of General Sir Thomas Brisbane, by whom it is believed to have been first transmitted to this country.[2] If not a true Epimachus, it certainly greatly resembles that genus, having the form and colouring of *E. magnificus*, and the same tendency (though less strongly developed) to an elongation of the lateral plumes. The obscure black and brown plumage of the female likewise corresponds to what M. Lesson regards as the sexual distinctions of the other species. We have had recent information, which confirms our former views, that it is not of honey-sucking propensities. It rather exhibits a tendency to scansorial habits; and in its search for insects its bill may be heard from some distance tapping the bark, like that of a woodpecker.

All the preceding groups of the Passerine Order belong to Cuvier's first primary division, which, as we said at starting (see page 567), is characterized by never having the outer united to the inner toe by more than the length of one or two phalanges.

Those which follow, on the contrary, forming the second and much less numerous primary division of our present order, have the outer toe almost as long as the middle one, and united to it as far as the base of the terminal articulation. Such a principle of division might, *a priori*, be inferred to lead to some serious mal-arrangement of the groups; for it is extremely unlikely that so trifling a character should be found in uniform accordance with other and more influential attributes, and the slightest study or most superficial inspection of this the *Syndactylous Division* of Baron Cuvier's passerine order will suffice to show that the said division is in many points extremely heterogeneous and unnatural. To prove this to the satisfaction of any one at all conversant with the character of the prevailing forms in Ornithology, it will suffice merely to enumerate its component parts, viz. the bee-eaters (*Merops*), the motmots (*Prionites*), the king-fishers (*Alcedo*), the todies (*Todus*), and the horn-bills (*Buceros*). It is indeed surprising that any one so gifted with the power of philosophical observation, so qualified by his profound acquaintance with comparative anatomy to trace the natural relations of living creatures, and so signally successful in his usual generalizations, should either have brought together, or permitted to remain in juxtaposition, so discordant a group. The regulating character supposed to be competent to amalgamate these discordant materials is alleged to consist simply in the close adherence of the outer and middle toe throughout a considerable portion of their length, that is, as far as the penultimate joints. Now, that this character by itself is of no avail in the formation of natural groups, is evident from two considerations:—1*st*, From its being found in numerous genera, which are admitted to bear no affinity to each other;—2*dly*, from its being absent in some of the component members of a natural family, and present in others. We may illustrate this by an example. In the South American genus *Ampelis* there are genuine species, in some of which the outer and middle toes are united, while in others they are free. This is well seen in the beautiful *Ampelis carnifex*, in which these parts are joined together, while in the closely allied species *A. pompadoura* they are disunited. Having called the reader's attention to this inconsistency, we shall proceed to a brief sketch of the different generic groups above named.

In the beautiful genus Merops, Linn., the bill is elongated, somewhat triangular at the base, slightly arched, sharp pointed. The wings are long, and narrow at the extremity. The feet are short. The flight of these birds, commonly called bee-eaters, is easy and buoyant, resembling that of the swallow. The species are numerous in Africa and the East; but only one is accustomed to show itself in Europe, the *Merops apiaster*, or *common* bee-eater of English writers (to whom, however, it is one of the rarest of the feathered race), an elegantly-formed and richly-plumaged bird (Plate CCCXCIV. fig. 2). It arrives in the southern countries of the Continent in March, and departs in September. It flies in flocks, usually at a considerable elevation, and utters with hoarse and guttural voice, in startling disaccordance with its slender aspect, a continual cry of *gra, gra, gra*. It builds in deep horizontal holes in sandy banks, which it excavates in whole or in part, working vigorously with feet and bill, and kicking out the dry earth behind it with great dexterity. It lays six or seven eggs, white, lucid, and almost spherical. When the young are partly fledged, but not yet fit to fly, they creep to the mouth of their holes, where they seem to enjoy the happy summer light and genial sunshine; but on the least alarm they trundle stern foremost into their inner chambers, where they lie concealed until tranquillity again prevails. So accustomed do they seem indeed to this peculiar movement, that when taken from the nest, and placed in any more exposed position, they seek to escape by running backwards. In fact, for a time they seem unable to walk in any other direction. All these birds are exclusively insectivorous, and prey almost entirely on the hymenopterous tribes. Although they often take their food upon the wing, they also gather it from the ground; and whenever they espy the small hole which leads into the nest of wasp or bembex, they place themselves close beside it, and snap up the industrious tenants on their exit or arrival. The Italian contadini regard the cry of the bee-eater as a sign of rain when they hear it uttered from a great height. The appearance of this beautiful bird in England is accidental. We may add, that none of the species occurs in America.

In the genus Prionites, Illiger, the feet and form are similar, but the bill is much stronger than in the preceding, the margins of both mandibles are crenulated (see Plate CCCXCIV. fig. 3), and the tongue is feathered. These birds are natives of South America. The plumage of their head is loose, like that of our common jay, the tail is long and graduated, and in adult birds the two central feathers are often bare or barbless for a space not far from the extremity. They prey on insects, occasionally attack small birds, and build their nests in the hollows of trees. Example, the blue-crowned motmot, *Ramphastos momota*, Gmelin.

The genus Alcedo, containing the king-fishers, has the legs still shorter than the bee-eaters, and the bill long, straight, angular, and pointed (CCCXCIV. figs. 1 and 4). As originally constituted, it contained a numerous assemblage of species from various countries of the world, of shape

[1] *Voyage de Duperrey*, pl. xxviii.

[2] *Illustrations of Zoology*, vol. i. pl. xi.

Insessores. and proportions rather awkward than elegant, but almost all remarkable for great splendour of plumage. The size and length of the bill are usually disproportioned to the body, and the feet and legs seem of a diminutive and apparently inconvenient form; but the shining silky lustre of the feathers, and their rich and infinitely varied hues of the most brilliant green and blue, contrasted with different shades of orange, black, and brown, render the genus one of the most showy and attractive within the entire range of the ornithological system. The *Alcedo ispida* (our common king-fisher) is the only species which occurs in Europe, and it yields to few of its brethren in its lustrous beauty. It is one of the rarest, and certainly the most highly adorned, of all our resident species. It haunts the banks of lakes and rivers, building in hollows near their margin, and preys chiefly on small fish, on which it darts with the rapidity of an arrow, plunging its little gem-like body for one flashing moment in the crystal stream.

Certain modifications observable in the form of the bill, and accompanied, as usual, by a corresponding change of habits, have induced the division of the original genus. For example, we owe to Dr Leach the formation of the genus Dacelo, of which the type is the giant king-fisher of New Holland (*A. gigantea* of Latham). The bill is very strong, curved at the extremity, and bulged beneath. These species (called *martin-chasseurs* by the French) inhabit forests, and build their nests, not in the excavated banks of rivers, but in the hollows of lofty trees; whereas the true king-fishers (*martin-pecheurs*) are never found at any distance from the "pure element of waters." The former also feed on insects rather than fish, and, the larger kind especially, are clothed in a dingier and less adorned plumage.

The one above alluded to (*D. gigantea*) is described by Mr Bennet as well known to the colonists of New South Wales by the name of laughing or feathered jackass,—a designation which occasioned a lady at home to declare, that of all the wonderful productions of Australia, she thought nothing could equal the "feathered donkey." Its peculiar gurgling laugh, commencing in a low and gradually rising to a louder tone, is often heard by travellers, proceeding from the branch of some lofty tree, where the bird is watching for its prey. It is said that one seldom laughs without being accompanied by another, apparently anxious to join in a duet. This bird is respected by Australian gardeners for destroying grubs, &c.; and Mr Bennet reports, that it also deserves protection on account of its devouring mice and venomous reptiles. "A gentleman told me he was perfectly aware of the bird destroying snakes, as he had often seen them carry the reptiles to a tree, and break their heads to pieces with their sharp, strong beaks." "One of these birds, seen upon the branch of a tree near a river, looking so stupid, and nodding as if asleep, was shot, and it was then found that this peculiar manner proceeded from its having swallowed a small snake, which had got into the stomach, throat, and bill, but had not yet accommodated itself in the former cavity."[1]

A rare and remarkable species, from the Moluccas, with a shorter bill than usual, and a much longer tail, sometimes called the ternate king-fisher (*A. dea*, Linn.), forms the genus Tanysiptera of Mr Vigors,—while a few small species which either want the inner toe, or possess it in a very rudimentary state, constitute the genus Ceyx of Lacepede. The latter occur in India. Example, *A. tribachys*, Shaw. (Plate CCCXCIV. figs. 5 and 11.)

The genus Todus contains some small American birds, supposed to resemble the king-fishers in their general form, their feet, and lengthened bills; but the latter organ is horizontally depressed, and obtuse at the extremity, the tarsi are more elevated, and the tail shorter. Their habits are insectivorous, and the species, very few in number as the group is now restricted, are by most Ornithologists arranged among the *Muscicapidæ*, near the genera *Platyrhynchus* and *Muscipeta*. The best-known, if not the only species, is the green tody (*T. viridis*, Linn.). It is found in the Antilles, and some of the equatorial regions of South America, where it hunts insects like a fly-catcher, but builds in holes in banks, after the manner of a king-fisher. Its nest is placed in a little chamber at the termination of a tortuous gallery, and both sexes are remarkable for their strong attachment to their young. This delightful bird is named ground-parrakeet by the Creoles of St Domingo. Though not very rare, it usually dwells in wild and solitary places, which is probably the reason of its being by no means frequent in the collections of Europe. The male utters an agreeable song during the pairing season, but at other times the green tody is a very silent bird. Its flight is straight and rapid, and it sits at times both on stones and trees. (Plate CCCXCIV. figs. 6, 7, and 9.)

The genus Buceros, which includes the calaos or horn-bills, is the last of the great passerine order in the arrangement of Baron Cuvier (Plate CCCXCIV. figs. 8 and 10). It certainly differs greatly from those near which he makes it stand, nor does it amalgamate much better with its neighbours in more recent systems. The species are natives of Africa and India, and are characterized by their enormous bills, toothed along their edges, and frequently surmounted by an additional horny structure, which bestows on them a very striking and peculiar physiognomy. These excrescences vary considerably with the age of the individual, and are scarcely perceptible in the young birds. The horn-bills may be said to resemble the toucans in their heads, the crows in their general habits, and the syndactylous tribes in the form of their feet. Their tongue is very small. These birds may be regarded as omnivorous, as they feed indifferently on fruits, mice, small birds, reptiles, and even carcasses. They exhibit an awkward and uncommon aspect while in the act of flying, in consequence of the great size of their beaks and lengthened tails, and altogether their appearance is extremely uncouth. Perhaps one of the most singular features in their economy consists in their feeding greedily, and without injury, on the seeds of *nux vomica*.[2]

The African horn-bill (*B. Africanus*) is entirely black, and nearly as large as a turkey. The crowned species (*B. coronatus*) is a much smaller bird, scarcely equalling the size of a magpie. Le Vaillant saw a flock of more than five hundred of these birds, in company with crows and vultures, preying on the remains of slaughtered elephants. It is figured by Mr Swainson in the third volume of the first series of his beautiful Illustrations. A large and remarkable Indian species has been of late years described by Mr Hodgson. It measures four feet five inches from tip to tip of the wings, and is three feet six inches in length. Its body exceeds that of the largest raven, but is very lean and incompact. It is believed to feed chiefly on fruits, although it will seize upon reptiles when pressed by hunger. Its freedom from any offensive smell, and the excellence of its flesh, which is much esteemed as an article of food, go far to prove that its habits are chiefly frugivorous. In a domestic state it will eat meat either raw or dressed. Mr Hodgson's specimen, however, was fed mostly on boiled rice, mixed with ghee, and made into large balls. It was never observed to take any water. Whenever it swallowed a mouthful which on second thoughts it considered as somewhat too large, it imme-

[1] *Wanderings in New South Wales*, i. 222.

[2] *Edinburgh Cabinet Library*, British India, iii. 90.

Scansores. diately disgorged it for the sake of a little additional mastication.[1]

Order III.—SCANSORES or CLIMBERS.

This somewhat heterogeneous group, continued by Baron Cuvier as a separate order, forms, in the systems of our own more recent writers, merely an additional tribe in the primary division of the passerine or insessorial order. As the zoological treatises in our present work have been hitherto made conformable to the general principles which regulate the arrangement proposed by the great French anatomist, we shall not here swerve from our previous practice, although we doubt not, that among some recent alterations for the worse, there may also be found not a few for the better. We fear, however, that it may be some time before the Scansores, even of the modern systems, can be regarded as composed of very closely allied groups,—at least so long as people feel averse to see any natural connection between a creeper and a cockatoo. Be this as it may, our present order is composed of species the great majority of which possess two toes before and two behind; that is, one of the three anterior toes commonly so called, is either reversible at pleasure, or is permanently thrown backwards, so as to give great power and tenacity of grasp during their infinitely varied movements over the rugged bark or smoother branches of the forest trees, on which they chiefly dwell. By this peculiar structure many species are enabled not only to ascend with ease a perpendicular trunk, but to suspend themselves from the lower surface of a branch while searching for their favourite food, which consists of fruits or insects, according to the form of the bill, so greatly diversified in the scansorial order. In the parrot tribe the foot is also used in the conveyance of food to the mouth, and generally as a prehensile organ of a very perfect kind.

We are aware that more than one excellent Ornithologist has objected to the title of this order, as incapable of being strictly applied to the whole of the genera of which it is composed. It is no doubt true that many of the species (such as the cuckoo), in which the toes are in pairs, or yoke-footed, cannot climb, while it is equally evident that several other species (such as the creeper, *C. familiaris*, the already alluded to very distant connection of the cockatoo) are excluded from this order by reason of the structure of their feet, in spite of which, however, they contrive to climb unceasingly; and that under these circumstances the denomination cannot be rigorously applied as alike characteristic of what it contains, and as correctly exclusive of what it does not contain. But we believe the same objection may be made to apply at least with equal force to various parts of every other system yet proposed. The ordinal characters, considered in their totality, are seldom so natural, yet extended, as to admit of no exception; and it is extremely questionable whether a title should be immediately changed upon the discovery of every species which may not coincide with its most rigorous interpretation. In truth, this could not in many cases be effected merely on the consideration of a single character, without producing greater inconveniences than those which it is desired to obviate. Among scansorial birds, for example, we have several species with only three toes, and which it would therefore be unreasonable to expect should conform to the ordinal character of having two toes before and two behind. But in spite of that partial deficiency, they are, in every essential particular, "true to their order."

The bill in the scansorial tribes varies so greatly in the different genera, from the straight, lengthened, angular mandibles of the woodpeckers, to the deep, curved, compressed organ of the parrots, that we must omit all consideration of it in the ordinal characters, although the study of its form is essential in relation to the minor divisions. The species of this order are, with few exceptions, inhabitants of the forests, and usually build their nests in the hollows of ancient trees. Their powers of flight are not remarkable. The European genera are almost entirely insectivorous; the parrot tribe feed on fruits; the toucans exhibit a tendency to the carnivorous habits of the accipitrine tribes; while other genera sensibly enjoy a mingled or miscellaneous diet.[2]

The genus Galbula, Brisson, has a straight, elongated, sharp-pointed bill, with the upper edge rather sharp; the legs are very short, and the anterior toes much united (Plate CCCXCV. fig. 1). The plumage of these birds, usually known under the name of *Jacamars*, is remarkable for its metallic lustre. The species inhabit South America, where they occur among trees in moist and marshy places. Examples, *G. paradisea* and *viridis*, Lath. They generally sit, according to Mr Swainson, on low naked branches in the forest paths, from whence they dart upon butterflies, spearing them with their long bills; and their haunts, indeed, may be frequently discovered by the ground being strewed with the beautiful wings of their mangled victims, the bodies of which they alone devour.[3] "A bird called jacamar," says Waterton, "is often taken for a king-fisher, but it has no relationship to that tribe; it frequently sits in the trees over the water, and as its beak bears some resemblance to that of the king-fisher, this may probably account for its being taken for one; it feeds entirely upon insects; it sits on a branch in motionless expectation, and as soon as a fly, butterfly, or moth passes by, it darts at it, and returns to the branch it had first left. It seems an indolent, sedentary bird, shunning the society of all others in the forest. It never visits the plantations, but is found at all times of the year in the woods. There are four species of jacamar in Demerara; they are all beautiful; the largest, rich and superb in the extreme. Its plumage is of so fine a changing blue and golden green, that it may be ranked with the choicest of the humming-birds. Nature has denied it a song, but given it a costly garment in lieu of it. The smallest species of jacamar is very common in the dry savannas. The second size, all golden green on the back, must be looked for in the Wallaba forest. The third is found throughout the whole extent of these wilds; and the fourth, which is the largest, frequents the interior, where you begin to perceive stones in the ground."[4] An Indian species (M. Lesson, however, assigns it to Cayenne), of which the bill is shorter, thicker, and somewhat arched, forms the genus Jacamerops of Le Vaillant (see Plate CCCXCV. fig. 2); and another from South America, with only three toes (*G. tridactyla*, Vieil.), constitutes the genus Jacamar-alcyon (Plate CCCXCV. fig. 3). These names, however unmusically composed, point out the natural relationship of our present group to the bee-eaters and king-fishers, with which (as *fissirostral* birds) they are combined in some modern systems.

The genus Picus, Linn., contains the well-marked, numerous, and extensively distributed tribe of woodpeckers, which occur in all the great divisions of the earth, with the exception of New Holland. The vast and solitary forests of North and South America are, however, their chief dominion, the greatest number, both there and in the old world, being found within the tropics. The bill is rather long, straight, angular, somewhat compressed or wedge-

[1] *Transactions of the Physical Class of the Asiatic Society of Bengal*, part i. p. 178.
[2] Wilson's *Illustrations of Zoology*, vol. i. art. Scansores.
[3] *Nat. Hist. and Class. of Birds*, ii. 154.
[4] *Wanderings*, p. 137.

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shaped at the extremity, and admirably fitted for splitting the bark or excavating the decayed portions of trees. The tongue is long, and capable of great protrusion, in consequence of its muscular basis, and the length of the horns of the *os hyoides*. It is not only furnished with little spines pointing backwards, but is covered by a glutinous moisture secreted by the salivary glands, which aids in the capture of the smaller insects, the larger, it is said, being usually transfixed by the point itself. The tail-feathers are very stiff and elastic, and greatly aid the motion of the feet in climbing, being pressed upon the bark, so as in some measure to support the body. Woodpeckers are shy and solitary birds. During the breeding season they dwell in pairs, and are only met with in small family flocks throughout the autumn. With the exception of the parrots, they form the most extensive group among scansorial tribes, between one and two hundred species being known to naturalists. We have only four in Britain, viz. the green woodpecker (*P. viridis*), our most common species; the great black woodpecker (*P. martius*), which is a much rarer bird; the great spotted woodpecker (*P. major*); and the lesser spotted kind (*P. minor*). Besides these, several others occur on the continent of Europe.

In whatever clime or country woodpeckers are found, they are characterized by strong affinities of form and colour, and constitute a very natural group, although some slight modifications of the bill have given rise in recent times to the formation of a few subgenera.

Buffon has drawn a melting picture of the miseries of a woodpecker's life. According to the views of the always eloquent, but frequently erroneous and sometimes inconsistent Frenchman, no bird which earns its subsistence by spoil leads a life of such painful and uninterrupted labour. Nature appears to have condemned it to incessant toil,—for while other species freely employ their courage or address, and either glide along on fearless rapid wings, or lurk insidiously in closer ambush, the woodpecker is constrained to drag on a miserable existence in boring through the scaly bark and tough unyielding fibres of the hardest trees. Necessity admits no intermission of its labours,—no interval of sweet repose. Not even the darkness of the night, nor sleep, that "soft restorer," who throws her balmy mantle over such a mass of human misery, brings any solace here,—for the nocturnal hours are spent in the same constrained and painful posture as are those of day. It never shares in the joyous sports of the other inhabitants of the woods, and so far from joining in their glad responses, it rather deepens the natural sadness of the forest glades by its wild and melancholy cries. Now, what is all this but the most fantastic coinage of the brain?—as if the blessed beings which people this gladsome world endured the primal curse, and shared the self-inflicted ruin of our race! as if their joyful hearts were ever pressed by sorrow, or responded in wailing sadness to the woes of man! Spirit of Eblis! not yet has thy malign influence so encroached upon the "Benigner Power." Is there any thing on earth for which we may not cry alas! saving only the omnipotent goodness of God, who careth "for all his creatures,"—and amid the unmeasured wretchedness which springs from human folly, the wan faces of our fellow-men pent up in close-built cities, the drunkard's hollow eyes, his shaking limbs, and tattered garments (and all the horrid ills that vice is heir to), what is more inspiring than to see even a fragment of the face of nature,—some little open plot of garden ground, where in spring the blackbird still may sing his evening hymn, or the autumnal red-breast cheerily announce approaching winter? Is there sorrow there or suffering, save what may spring from some dark spirit in the mind of man, the "immortal rebel?" When Buffon himself, a great interpreter of nature, in spite of all his fitful fancies, yielded up his life to God who gave it, did the lilied fields of France reflect the sun's warm rays less brightly, or her sylvan choristers welcome with sadder note the rosy day-break of the ensuing morn; or when that more wretched hour arrived (which the hoary but irreverent parent was saved the pain to see) when his son's fair locks, dishevelled but not dishonoured, were streaming on the blood-stained floor of that insatiate scaffold, what cared the gladsome birds in field or tree? It would indeed be but a doleful thought, if misery such as man so often meets with among human kind, and which he is therefore prone to picture, were to spread itself from his own sad bosom into the depth of darkly shaded forests, where so many gorgeous feathered inmates dwell, or among ocean rocks amid upheaving waters, or wave-worn caves, or crystal rivers with their golden sands.

Let those who dwell with pity on the fate of our condemned bird go with us to America, and listen to the high-toned note of *Picus principalis* (the name itself might "threaten and command"), echoing from the giant trunk or moss-grown arm of some colossal tree, or watch his varied movements, while from gnarled stems he drives off impetuously broad flakes of flashing bark, which so accumulate around the base of pine or cypress, as if a human carpenter had there set up his habitation. Or if we cannot go to America, let us read a great observer's history of another species. "No sooner," says Audubon, "has spring called them (the golden-winged woodpeckers) to the pleasant duty of making love, than their voice, which by the way is not at all disagreeable to the ear of man, is heard from the tops of high decayed trees, proclaiming with delight the opening of the welcome season. Their note at this period is merriment itself, as it imitates a prolonged and jovial laugh, heard at a considerable distance. Several males pursue a female, reach her, and to prove the force and truth of their love, bow their heads, spread their tails, and move sideways, backwards and forwards, performing such antics as might induce any one witnessing them, if not of a most morose temper, to join his laugh to theirs. The female flies to another tree, where she is constantly followed by one, two, or even half a dozen of these gay suitors, and where again the same ceremonies are gone through. No fightings occur, no jealousies exist among these beaux, until a marked preference is shown to some individual; when the rejected proceed in search of another female. In this manner all the golden-winged woodpeckers are soon happily mated. Each pair immediately proceed to excavate the trunk of a tree, and finish a hole in it sufficient to contain themselves and their young. They both work with great industry and apparent pleasure. Should the male, for instance, be employed, the female is close to him, and congratulates him on the removal of every chip which his bill sends through the air. While he rests he appears to be speaking to her on the most tender subjects, and when fatigued is at once assisted by her. In this manner, by the alternate exertions of each, the hole is dug and finished. They caress each other on the branches, climb about and around the tree with apparent delight, rattle with their bill against the tops of the dead branches, chase all their cousins the red-heads, defy the purple-grakles to enter their nest, feed plentifully on ants, beetles, and larvæ, cackling at intervals, and ere two weeks have elapsed, the female lays either four or six eggs, the whiteness or transparency of which are doubtless the delight of her heart. If to raise a numerous progeny may contribute to happiness, these woodpeckers may be happy enough, for they have two broods each season. Even in confinement the golden-winged woodpecker never suffers its naturally lively spirit to droop. It feeds well, and by way of amusement will contrive to destroy as much furniture in a day as can well be mended by a different kind of workman in two. Therefore, kind reader, do not any longer believe that woodpeckers, I mean those of

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America, are such stupid, forlorn, dejected, and unprovided-for beings, as they have hitherto been represented."[1]

The other species to which we have above alluded is the beautiful ivory-billed woodpecker (*Picus principalis*, Linn.), of which the broad extent of dark and glossy plumage, with the well-defined snowy markings of the neck and wings, relieved by the rich tracery of the carmine crest, and brilliant yellow eye, in some way so reminded the enthusiastic Audubon of the noble productions of a great Flemish painter, that whenever he saw one of these gorgeous birds flying from tree to tree, he would exclaim, "There goes a Vandyke." The ivory-billed woodpecker confines its rambles to a comparatively small portion of the United States, and is never observed in the middle portions of the Union, where the nature of the wood does not appear to suit its habits. "Descending the Ohio," says Mr Audubon, "we meet with this splendid bird for the first time near the confluence of that beautiful river and the Mississippi; after which, following the windings of the latter, either downwards towards the sea, or upwards in the direction of the Missouri, we frequently observe it. On the Atlantic coast, North Carolina may be taken as the limits of its distribution, although now and then an individual of the species may be accidentally seen in Maryland. To the westward of the Mississippi, it is found in all the dense forests bordering the streams which empty their waters into that majestic river from the declivities of the Rocky Mountains. The lower parts of the Carolinas, Georgia, Alabama, Louisiana, and Mississippi, are however the most favourite resorts of this bird, and in those states it constantly resides, breeds, and passes a life of peaceful enjoyment, finding a profusion of food in all the deep, dark, and gloomy swamps dispersed throughout them. I wish, kind reader, it were in my power to present to your mind's eye the favourite resort of the ivory-billed woodpecker. Would that I could describe the extent of those deep morasses, overshadowed by millions of dark gigantic cypresses, spreading their sturdy moss-covered branches, as if to admonish intruding man to pause and reflect on the many difficulties which he must encounter should he persist in venturing farther into their almost inaccessible recesses, extending for miles before him, where he would be interrupted by huge projecting branches, here and there the massy trunk of a fallen and decaying tree, and thousands of creeping and twining plants of numberless species! Would that I could represent to you the dangerous nature of the ground, its oozing, spongy, and miry disposition, although covered with a beautiful but treacherous carpeting, composed of the richest mosses, flags, and water-lilies, no sooner receiving the pressure of the foot than it yields, and endangers the very life of the adventurer, whilst here and there, as he approaches an opening, that proves merely a lake of black, muddy water, his ear is assailed by the dismal croaking of innumerable frogs, the hissing of serpents, or the bellowing of alligators! Would that I could give you an idea of the sultry pestiferous atmosphere, that nearly suffocates the intruder during the meridian heat of our dogdays, in those gloomy and horrible swamps! But the attempt to picture these scenes would be vain. Nothing short of ocular demonstration can impress any adequate idea of them.

"The flight of this bird is graceful in the extreme, although seldom prolonged to more than a few hundred yards at a time, unless when it has to cross a large river, which it does in deep undulations, opening its wings at first to their full extent, and nearly closing them to renew the propelling impulse. The transit from one tree to another, even should the distance be as much as a hundred yards, is performed by a single sweep, and the bird appears as if merely swinging itself from the top of the one tree to that of the other, forming an elegantly curved line. At this moment all the beauty of the plumage is exhibited, and strikes the beholder with pleasure. It never utters any sound whilst on wing, unless during the love season; but at all other times, no sooner has this bird alighted, than its remarkable voice is heard, at almost every leap which it makes, whilst ascending against the upper parts of the trunk of a tree, or its highest branches. Its notes are clear, loud, and yet rather plaintive. They are heard at a considerable distance, perhaps half a mile, and resemble the false high note of a clarionet. They are usually repeated three times in succession, and may be represented by the monosyllable, *pait, pait, pait.* These are heard so frequently, as to induce me to say that the bird spends few minutes of the day without uttering them; and this circumstance leads to its destruction, which is aimed at, not because (as is supposed by some) this species is a destroyer of trees, but more because it is a beautiful bird, and its rich scalp, attached to the upper mandible, forms an ornament for the war-dress of most of our Indians, or for the short pouch of our squatters and hunters, by all of whom the bird is shot merely for that purpose.

"Travellers of all nations are also fond of possessing the upper part of the head and the bill of the male; and I have frequently remarked, that on a steam-boat's reaching what we call a *wooding-place*, the *strangers* were very apt to pay a quarter of a dollar for two or three heads of this woodpecker. I have seen entire belts of Indian chiefs closely ornamented with the tufts and bills of this species, and have observed that a great value is frequently put upon them. The food of this species consists principally of beetles, larvæ, and large grubs. No sooner, however, are the grapes of our forests ripe, than they are eaten by the ivory-billed woodpecker with great avidity. I have seen this bird hang by its claws to the vines, in the position so often assumed by a tit-mouse, and, reaching downwards, help itself to a bunch of grapes with much apparent pleasure. Persimons are also sought for by them, as soon as the fruit becomes quite mellow, as are hag-berries. The ivory-bill is never seen attacking the corn, or the fruit of the orchards, although it is sometimes observed working upon and chipping off the bark from the belted trees of the newly-cleared plantations. It seldom comes near the ground, but prefers at all times the tops of the tallest trees. Should it, however, discover the half-standing broken shaft of a large dead and rotten tree, it attacks it in such a manner as nearly to demolish it in the course of a few days. I have seen the remains of some of these ancient monarchs of our forests so excavated, and that so singularly, that the tottering fragments of the trunk appeared to be merely supported by the great pile of chips by which its base was surrounded. The strength of this woodpecker is such that I have seen it detach pieces of bark seven or eight inches in length at a single blow of its powerful bill, and by beginning at the top branch of a dead tree, tear off the bark, to an extent of twenty or thirty feet, in the course of a few hours, leaping downwards with its body in an upward position, tossing its head to the right and left, or leaning it against the bark to ascertain the precise spot where the grubs were concealed, and immediately after renewing its blows with fresh vigour, all the while sounding its loud notes, as if highly delighted.

"When wounded and brought to the ground, the ivory-bill immediately makes for the nearest tree, and ascends it with great rapidity and perseverance, until it reaches the top branches, when it squats and hides, generally with

[1] *Ornithological Biography*, vol. i. p. 191.

great effect. Whilst ascending, it moves spirally round the tree, utters its loud *pait, pait, pait,* at almost every hop, but becomes silent the moment it reaches a place where it conceives itself secure. They sometimes cling to the bark with their claws so firmly, as to remain cramped to the spot for several hours after death. When taken by the hand, which is rather a hazardous undertaking, they strike with great violence, and inflict very severe wounds with their bill as well as claws, which are extremely sharp and strong. On such occasions, this bird utters a mournful and very piteous cry."[1]

A few species in which the bill is obviously arched form the genus Colaptes of Mr Swainson. They seem, moreover, distinguished by the broad, bright-coloured shafts of the quill-feathers. Such is the gold-winged woodpecker (*P. auratus*) already alluded to. These birds *perch* more frequently than the genuine woodpeckers, that is, grasp or encircle the smaller branches, and they also often feed upon the ground. A Brazilian species is even named *P. campestris,* from its habit of searching about in fields and plains for insects in the dung of cattle, or on ant-hills, where it finds an ample supply of favourite food. This form occurs also in Africa. Certain three-toed species were formed into the genus Picoides by Lacepede. (Plate CCCXCV. fig. 3.)

The genus Yunx of Linn., containing the wrynecks, remarkable for their beautifully brindled plumage, is of very limited extent. The sole European species (*Yunx torquilla*) is in Britain a rare but regular summer bird of passage, breeding in hollow trees, laying numerous eggs, and feeding on insects. The genus Picumnus of Temm. is nearly allied, but is distinguished by its extremely short tail. Example, *P. abnormis*, Temm. *Pl. Col.* 371, fig. 3, which comes from Java. *Picus minutus*, which some authors place here, is by others regarded as a *Yunx*.

In the genus Cuculus of Linn. were originally placed a number of different insectivorous birds, commonly called cuckoos, which agreed in the general form of the feet, the lengthened tail, the bill of medium size, rather deeply cleft, somewhat compressed, and slightly curved. But they have since been formed into numerous minor groups, the most marked and conspicuous of which we shall here briefly notice.

The true cuckoos, genus Cuculus, Cuv., have the bill of moderate strength, the tarsi short, and the tail of ten feathers. As an example, we name our common British species, *C. canorus*, so remarkable for its singular and somewhat anomalous habit of depositing its eggs in the nests of other birds, a fact now so well known, and so frequently recorded, that we need not here dilate upon the subject, however curious in itself. The nest of the hedge-sparrow (*Accentor modularis*) is that most usually chosen in the south of England,—that of the yellow-hammer (*Emb. citrinella*), the wagtail (*Mot. alba*), and the meadow titlark (*A. pratensis*), being, however, likewise devoted to the purpose. "In Northumberland," says Mr Selby, "constant experience tells me, that the nest of the last-mentioned bird is the one almost always chosen. Taking advantage of the absence of its dupe during the time of laying (which generally occupies four or five days), the cuckoo deposits its egg among the rest, abandoning it from that moment to the care of the foster-parent. As the same period of incubation is common to both birds, the eggs are hatched nearly together, which no sooner takes place than the young cuckoo proceeds instinctively to eject its young companions and any remaining eggs from the nest. To effect this object, it contrives to work itself under its burden (the back at this early age being provided with a peculiar depression between the shoulders), and shuffling backwards to the edge of the nest, by a jerk rids itself of the incumbrance; and this operation is repeated, till the whole being thrown over, it remains sole possessor. This particular tendency remains for about twelve days, after which the hollow space between the shoulders is filled up; and when prevented from accomplishing its purpose till the expiration of that time, as if conscious of inability, it suffers its companions to remain unmolested."[2]

Various supposed reasons have been assigned for this anomalous, and we might almost say unnatural, instinct. Some have attributed it to the displacement of certain viscera (the gizzard is said to be situate farther back than in most other birds), which unfits them for the purposes of incubation, while others imagine that the early period at which cuckoos migrate from this country (they are generally off by the beginning of July) makes it necessary that they should leave their offspring to the care of foster-parents.[3] But anatomical investigation has not proved any thing sufficiently peculiar in their structure to warrant the first conclusion; and as to the second, it seems to us not so much a deduction from a regulating and causative fact in their history, as the statement of an additional circumstance which renders that history still more singular, and which naturally leads to the question, not easily answered, of why do they migrate so early?[4] In short, we know nothing at all about the matter, further than that the cuckoo of Europe, like the cow-bunting of America, always lays eggs, but never hatches them. The same custom is alleged, we think upon a narrow and ill-considered generalization, to characterize the other kinds of cuckoo. It may be a practice common to several species, but the rare black and white spotted cuckoo (*Cuculus Pisanus*, Gm., an odd name for an African bird, which happened once upon a time to visit Tuscany) is stated by the authors of the *Storia degli Uccelli* to have *built a nest* in the woods of Pisa, and *reared four young ones*. This species is extremely rare in Europe. It is known, however, in the Genoese territory,[5] and the young have been occa-

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[1] *Ornithological Biography*, i. 341. [2] *British Ornithology*, vol. i. p. 398. [3] *British Ornithology*, vol. i. p. 399.

[4] Besides, in Italy and other southern parts of Europe, this migration does not take place till September, and yet the habits of the bird are precisely the same. "Quelli uccellini," says Savi, "nel covo de' quali il cuculo ha lasciato l'uovo, non vi fanno attenzione; come uno de' loro seguitano a covarlo, e quando è nato imboccano e custodiscono il piccolo cuculo, con lo stesso amore, e con la cura medesima de' figli propri. Ma ben presto egli paga d'ingratitudine le premure dell'amorosa sua balia: crescendo molto più de' compagni, dopo poco tempo il nido è per lui troppo stretto: allora ricorre a un barbaro espediente per procurarsi un alloggio più comodo:" &c...."Ripete quest' operazione successivamente, in ragione che cresce, e che gli altri compagni lo incomodano, di modo che alla fine rimane solo nel nido usurpato. Così quei miseri uccelli che construirono il nido e che han fatto da balia al cuculo, sono da lui privati ad uno ad uno di tutti i figli." Regarding the movements of the parent bird in Italy, he observes, "E uccello migratorio: arriva nell' Aprile, e parti in Settembre. Appena arriva comincia a cantare, e quantunque il suo verso non abbia alcuna varietà, non ostante la voce essendo dolce e rotonda, si sente con piacere. Grandissimo è il numero che ne rimane in Toscana: non vi è bosco in monte o in piano, che in primavera ed in estate, non risuoni dal *cu cu, cu cu*, di questo uccello. Nel Settembre comincia a muoversi per emigare: allora in alcuni anni se ne vede passare una quantità grandissima per la pianura Pisana. Nel Settembre del 1823, gli alberi dello stradone che da Pisa va al Parco Reale di S. Rossore, attraversando vastissime praterie, ne furono pieni per una diecina di giorni. Volavano i cuculi da una pianta all' altra, andavano a posarsi un poco sul prato, ritornavano sugli alberi, ma di là non si allontanavano, benchè continuamente fossero molestati dai non pochi cacciatori che vi erano acccorsi. Questi uccelli volano con grande agilità, e spesso, particularmente andando a posarsi, senza muovere le ali, come sogliono fare i Falchi." (*Ornitologia Toscana*, t. i. p. 152.)

[5] Calvi, *Catalogo d'Ornitologia di Genova*, p. 55.

Scansores. sionally killed in the south of France.[1] Many beautiful cuckoos are found in foreign countries.

Those of North America belong to the genus Coccyzus of Vieillot, and are distinguished by a greater length of tarsus. (Plate CCCXCV. fig. 4.) They seem to delight more in deep woody solitudes than the true cuckoos, the latter being often found on hilly pastures and open heathy ground, if fringed with wood. A stranger who visits the United States for the purpose of examining their natural productions, and passes through the woods in May or June, will sometimes hear, as he traverses the borders of deep, retired, high-timbered hollows, an uncouth guttural sound. He will frequently hear this without being able to discover the source from which it comes, as the yellow-billed cuckoo (*Coccyzus Americanus*) is both shy and solitary, and always seeks the thickest foliage for concealment. This bird is of a grayish brown, with bronzed reflections, beneath white, the inner vanes of the primaries reddish cinnamon colour, the lower mandible white, and the length from bill to tail about twelve inches. Considerable discussion has taken place among philologists regarding the native languages of North and South America,—remarkable, we are led to understand, for their great number and striking dissimilarity. We know not what may be the intention of the yellow-billed cuckoo in speaking as he does, or whether he is distinctly comprehended by his neighbours; but the following is Mr Nuttall's account of the elements of his conversation: "The male frequently betrays his snug retreat by his monotonous and guttural *kow kow kow kow*, or *koo koo koo koo*, and *ko kuk, ko kuk, koo koo koo kuk, koo ko koo, koo ko koo*, uttered rather plaintively, like the call of a dove. At other times the *kow kow kow kow*, and *'tk 'tk 'tk 'tk 'tak*, or *'kh 'kh 'kh 'kh 'kak, kow kow kow kow*, beginning slow, rises, and becomes so quick as almost to resemble the grating of a watchman's rattle, or else, commencing with this call, terminates in the distant cry of *kow kow kow*." From this peculiar iteration (Shakspeare would have called it "damnable," a word we sometimes hear in pulpits, but ourselves but seldom use), the species in question has received the name of *kow*-bird, and we do not wonder at it. It may be satisfactory to know, that the St Domingo cuckoo (*C. Dominicus*, Nut.) although it sometimes cries both *kow kow kow kow* and *'kh 'kh 'kh 'kh 'kh 'kak*, yet often utters, in a raucous guttural voice, especially preceding rain, a word which sounds like *orrattottoo* or *worrattottoo*, exactly which has not been yet determined.

In the genus Centropus of Illiger the bill is compressed and carinated, and the nail of one of the hind toes is long, straight, and pointed, like a lark's. The tail is greatly elongated. The species are native to India and Africa, where they build in hollow trees, and feed on locusts and other insects. Such are *Cuculus Ægyptius, Senegalensis, Bengalensis*, &c. The genus Leptosomus of Vieillot is constituted by the great Madagascar cuckoo (*C. cafer*, Lath.—*Lep. viridis*, Vieil.), the female of which, as described by Buffon, is according to M. Lesson a distinct species—*Lept. crombus*. These birds are said to be frugivorous. (Plate CCCXCV. fig. 5.)

In the genus Indicator, Vail., the bill is short, high, almost conical. (Plate CCCXCV. fig. 6.) The tail consists of twelve feathers, and is somewhat graduated, and at the same time a little forked. The skin is described to be so hard and tough as to resist the assaults of most hymenopterous insects; but bees, which they incessantly torment, are said to sting them in the eyes. The species, few in number, are known by the name of honey-guides, and inhabit Africa. The one mentioned by Sparrman is said to attract the notice of the Dutch and Hottentots by a shrill cry of *cher, cher*; and when it perceives itself observed, it flutters onwards to the hive of a wild bee, in hopes of partaking of the plundered honey. "I have had frequent opportunities," he observes, "of seeing this bird, and have been witness to the destruction of several republics of bees, by means of its treachery. I had, however, but two opportunities of shooting it, which I did, to the great indignation of my Hottentots." It may be here noticed, we hope without offence, that naturalists themselves seem not seldom to belong to that *irritabile genus*, of which poets are usually supposed to form the greater portion. Though Dr Sparrman asserts that he was a frequent eye-witness of the curious instinctive habits of the honey-guide, yet Vaillant doubts if that traveller ever saw the bird at all. He says that the account is merely a repetition of a fable believed and repeated by credulous people at the Cape, and that it is erroneous to suppose that the bird seeks to draw man after it for the purpose of sharing the plundered sweets, the fact being, that it calls not the man, but that the latter knows, by attending to the cry of the honey-guide while searching for its natural food, that he will be sure ere long to find the stores of the industrious insect. According to Bruce, the *moroc*, for so this singular species is sometimes named, occurs in Abyssinia; and he too throws discredit on Sparrman's statements,—his own being but ill received by not a few. However, Sir John Barrow, a careful and accurate inquirer, though not a professed naturalist, confirms it by stating that people in the interior of the South of Africa are too well acquainted with the moroc to have any doubts, either as to the bird itself, or its singular instinctive habits.

The *Barbacous* of Vaillant (genus Monasa, Vieil.) are South American birds, with rather conical elongated bills, slightly arched towards the tip, and furnished at the base with setaceous feathers. (Plate CCCXCV. fig. 7.) Such are *Cuc. tranquillus* and *tenebrosus* of the older systems, and the *Bucco albifrons* of Spix. We believe they are insectivorous. The *Malcohas* of Vaillant, again (genus Phœnicophæus, Vieil.), are Asiatic species, of which the most anciently known is native to Ceylon. (Plate CCCXCVI. fig. 1.) We here place the *Cuculus curvirostris* of Shaw, Latham's red-headed cuckoo, *C. pyrrhocephalus* of Forster, &c. and certain recent species described by Dr Horsfield and Sir Thomas Raffles. The preceding groups were all regarded as cuckoos by the older authors.[2]

The genus Scythrops of Latham, however, has a much stronger bill than any of these, marked by two slight longitudinal furrows. There is a naked space around the eye, and the nostrils are rounded. Only a single species is yet known, *Sc. Novæ Hollandiæ*, Lath., sometimes called the channel bill, a most peculiar looking bird, of the size of a crow, gray above, beneath dingy white. (Plate CCCXCVI. fig. 2.) In its bill it almost assimilates to the toucans, but its tongue is simple. Though it is mentioned both by White and Phillips, we know as yet but little of its habits. It occurs in New Holland, where it is sometimes seen in small flocks, but more usually in pairs, frequenting trees, and uttering during flight a loud and screaming cry, not unlike the crowing of a cock. Its food is said to consist both of fruits and insects. It also occurs in the Celebes, where its voice presages rain.

The genus Bucco of Linn., is characterized by a thickish conical beak, bulged laterally from the base, and furnished with five fasciculi of barbs directed forwards. The wings

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[1] Roux, *Ornithologie Provençale*, p. 105.
[2] For the various modifications of form exhibited by the Cuculidæ, and the numerous minor groups which have thence resulted, see M. Lesson's *Traité d'Ornithologie*, and a recent paper by Mr Swainson in the *Magazine of Zoology and Botany*.

are short, and the flight heavy. The species feed on fruits and insects, and occasionally attack small birds. They build their nests in hollow trees. Cuvier divides them into three minor groups. The *Barbicans* of Buffon (POGONIAS, Illiger) have one or two strong teeth on each side of the upper bill, of which the ridge is arched and blunt. The barbs are very strong. (Plate CCCXCVI. fig. 3.) The species occur in Africa and India, and are more frugivorous than their congeners. Example, *P. sulcirostris*, Leach, *Zool. Misc.* xi. 76. The Barbus (genus BUCCO, as restricted) have the bill simply conic, slightly compressed, the culmen blunt, and a little raised about the centre. The species live in pairs during the breeding season, and in small flocks at other times. They occur in both continents, and are adorned with lively colours,—*Bucco grandis, viridis, flavifrons*, &c. Lastly, the *Tamatias*, genus TAMATIA, Cuv., have the bill more elongated and compressed, with the extremity of the upper mandible curved downwards. Their thick heads, large bills, and short tails, give them a stupid aspect. They inhabit South America, feed on insects, and are of solitary habits. Example, *T. melanoleucos*; *melanotis*, &c. They are known by the English name of *puff-birds*; and Mr Swainson describes them as sitting for hours together on a dead or withered branch, from which they dart from time to time on such unwary insects as approach within their reach. He adds, that the hermit-birds (genus *Monasa*), already mentioned, do the same, and frequently rise up perpendicularly into the air, making a swoop, and returning again to their former station. Similar manners belong to the jacamars, though their flight is weaker.

In the genus TROGON the bill is also bearded, but short, and broader than high, the upper edge rounded. Their little feet are often feathered almost to the toes, and their soft, full, lax plumage, and lengthened tails, bestow upon the species a peculiar aspect. (Plate CCCXCVI. fig. 4.) These birds abound in South America, where they conceal themselves in the central solitudes of umbrageous forests, and, except during the breeding season, dwell insulated and alone. They will sit motionless for half a summer's day, often upon a withered branch, and if not concealed by some accidental intervening mass of foliage, they fall an easy prey to the keen-eyed hunter, who eagerly searches for birds not less remarkable for the delicacy of their flesh than the beauty of their plumage. During the morning and evening hours, Mr Swainson informs us, they become more active; venturing at these times into the open parts of the forest, and, taking a shady station, dart upon winged insects, particularly beetles. At other times they feed upon fruits, especially the rich purple berries of the different melastomæ, "at which," says Mr Swainson, "they invariably dart, precisely as if they were insects capable of getting away." It has been remarked by the woodland hunters, that the skins of these birds are of such delicate texture as to be with difficulty preserved in a natural or complete condition. It is probably for this reason that in museums they exhibit a heavy, shapeless aspect, redeemed, it is true, by the gorgeous colours or metallic splendour of their plumage. The most magnificent of the genus is the quezal or golden trogon (*T. pavoninus*, Temm.), a rare and remarkable species, of which neither delineation nor description can convey an adequate idea. The greater proportion of the plumage is apparently composed of burnished gold. The head ornamented by a brilliant crest of decomposed barbs, the wing-coverts falling in flakes of golden green over the deep purplish-black of the primary and secondary quill-feathers, the rich carmine of the lower parts bestowing a warmth and depth of effect which no Venetian painter ever equalled, and the long waving and highly metallic feathers of the tail-coverts, extending about three times the length of the whole body, present a combination of beauty almost unexampled in the feathered tribes. The first specimens seen in this country were brought, we believe, by Mr Schenley from Vera Paez, in central America. They are celebrated in the Mexican mythology, and are much sought after as head-gear by the Peruvian damsels. Trogons, of other kinds, occur also in the Indian islands, and the warmer continental regions of the old world.[1]

The genus CROTOPHAGA, Linn., is recognised by its thick, compressed, arched bill, without dentation, elevated, or surmounted by a vertical cutting crest. (Plate CCCXCVI. fig. 5.) The species called *anis* or keel-birds inhabit South America and the West Indies. They are of a familiar and gentle disposition in confinement, easily tamed, and may be taught to speak. Their plumage is black, with metallic reflections. They build in bushes (some say upon the ground), and several pairs will lay and hatch together in the same nest, which is made of size proportioned to the partnership. They feed on insects, keep much upon the ground, where they also attack maize and rice. M. Lesson says that *C. major* dwells more habitually on large trees, while *C. minor* prefers the savannahs and marshy meadows. Mr Swainson never saw the common ani perch on any thing higher than a bush.

The genus RAMPHASTOS, Linn., is distinguished by its enormous bill, which in some instances is almost equal in size to the body. It is, however, extremely light, and cellular within, arched towards the extremity, and irregularly toothed along the margins. The tongue is long, narrow, and barbed on each side, like a feather. These birds, commonly called toucans, inhabit South America, where they live habitually in woods, and prey on fruits, eggs, and new-hatched birds. The species are pretty numerous, and almost all distinguished by brilliant colouring, which however is somewhat too strongly contrasted, and consequently deficient in that fine gradation or harmonious blending which beautifies less gorgeous tribes. We have never chanced to see them in the living state, but in museums they present a somewhat awkward aspect, from their disproportioned bills, short feet, and lengthened tails. Their sense of smell is said to be extremely acute,—a faculty by some attributed to an extended ramification of nerves within the nasal portion of the bill. The genus is now divided into two: 1*st*, The toucans proper (genus RAMPHASTOS, Plate CCCXCVI. fig. 6), which have the largest bills, with the ground colour of the plumage usually black, the throat, breast, and rump being more gaily ornamented with white, yellow, and red. 2*dly*, The aracaris (genus PTEROGLOSSUS, Illiger, Plate CCCXCVI. fig. 7), in which the bill is smaller than the head, and the ground colour of the plumage generally green, with red or yellow on the throat and breast. A live specimen of *Ramphastos tucanus*, of which the manners have been described by Mr Vigors, was extremely fond of fruit, both fresh and dried. These it generally held for a short time in the extremity of the bill, touching them with apparent delight with its slender feathered tongue, and then tossing them into its throat by a sudden upward jerk. Its tendency to prey on animals was, however, strongly evinced by the excitement produced by the sight of a living bird; and the carnivorous propensities of another individual are curiously related by Mr Broderip. A goldfinch (though, we repeat, we approve not of the fact), introduced into the toucan's cage, was seized and compressed so suddenly, that the poor little songster had only time to utter a short squeak before it was dead, with its bowels protruding. The toucan then hopped with it to

[1] Mr Gould has published a *Monograph of the Trogonidæ*, with sumptuous coloured plates.

another perch, and began to strip off its feathers. When it was nearly naked, it broke the bones of the wings and legs, taking them in its bill, and giving them a strong lateral wrench. Having reduced the little victim to a shapeless mass, it first swallowed the viscera, and then the remaining parts, piece after piece, not even rejecting the legs and bill. Mr Broderip adds, that he has sometimes observed it return its food from its crop, and swallow it again, after a second mastication.

The genus PSITTACUS, Linn., comprehending the almost innumerable tribe of parrots, lories, parrakeets, maccaws, and cockatoos, has the bill thick, hard, solid, rather short, rounded on all its outlines, deep, curved, and generally sharp-pointed. The tongue is almost always thick, round, and fleshy, and the lower larynx furnished on each side with three peculiar muscles, which probably contribute to the great facility with which these birds acquire the articulate intonation of the human voice. Their strong and powerful jaws are brought into action by muscles more numerous than usual. Their natural food consists of fruits and seeds. They climb trees with the greatest facility, and suspend themselves indifferently from feet or bill. Their voices are harsh and discordant, their forms often elegant, their plumage usually of great richness. They form indeed a magnificent family, abundant in almost every region of the torrid zone, and in the new world extending from the shores of the Ohio to the Straits of Magellan,—thus presenting a vast and varied assemblage of species from every country of the world, excepting the comparatively cold and cloudy clime of Europe. The gorgeous maccaws are characteristic of South America, the cockatoos of New Holland and the Asiatic islands, the lories of the East Indies and the Moluccas; whilst several groups of parrots, parrakeets, &c. are widely distributed over various regions of the earth. Above two hundred different kinds are known to naturalists.

It was the opinion of Buffon that none of the parrot tribe extended either northwards or southwards beyond the twenty-fifth degree, on either side of the equator. Having apparently resolved, *a priori*, on these lines of circumvallation, he despised, as Pennant observed, the authority of the Dutch navigator Spilbergen, who was eye-witness to the woods of Terra del Fuego, the very southern boundary of the Straits of Magellan, in south latitude 44°, being full of them. He might also have cited the evidence of Captain Hood, who saw a parrot at Port Famine; and of Commodore Byron, who notwithstanding the coldness of the climate observed parrots innumerable in the woods of that same harbour. They were found by Captain Cook in New Zealand, by Captain Furneaux at Van Diemen's Land, and by the learned Forster in the raw wet climate of Dusky Bay. The emerald parrot, *Psit. smaragdinus*, Gmel., was lately seen in great numbers by Captain King, among thick underwood, in the Straits of Magellan, south latitude 53½°; and others are well known to occur in Macquarrie Island, which lies in latitude 54¼° south. A species inhabits North America, extending even beyond the Illinois River to the neighbourhood of Lake Michigan, in the forty-second degree of north latitude. It was seen by Alexander Wilson in the month of February, flying in flocks along the banks of the Ohio, during a storm of snow, and yet in full rejoicing cry. These, and many similar facts, are now well known to naturalists.

The modern subdivisions of this great natural family are too numerous and minute to be here recorded.[1] We must therefore satisfy ourselves with a brief indication of the principal groups. We presume nobody at this time of day, under the pretence of *popular* reading, desires to be edified by anecdotes of parrots, so we shall devote the little space we can afford for miscellaneous matters, to a few notices of some of the species which have bred in Europe. Of these we may here mention, as the principal, the great blue and buff maccaw (*P. ararauna*); the gray parrot (*P. erythacus*); the sinciale, ring-necked, and pavouan parrakeets (*P. sincialo, torquatus, Guianensis*); and the black-capped or Philippine lory (*P. tricolor*). The general belief is that the parrot tribe will not breed in Europe; but knowing several instances to the contrary, we wish to impress upon the public the probability that many more would occur were the experiment tried with frequency and judgment.

The gorgeous maccaws form the genus MACROCERCUS of Vieillot. The face is either naked, or merely striped with feathery lines. The tail is very long, wedge-shaped, and sharp-pointed. (Plate CCCXCVII. fig. 1.) These birds, the largest and most magnificent of the parrot tribe, inhabit South America. The great scarlet maccaw (*Psittacus aracanga*, Lath.), when in perfect plumage, sometimes measures above three feet in length, the tail of course included. The prevailing plumage is scarlet, as its name implies, the wings blue, the wing-coverts varied with yellow, the cheeks white and wrinkled. It is certainly a sumptuous creature, but after all rather too like a richly liveried footman,—an association somewhat strengthened by its being so often seen as an inhabitant of lordly mansions, and surrounded by other menial bipeds, almost as gorgeous as itself. Our feelings would no doubt have been different had we ever witnessed their natural evolutions. "It is a grand sight in Ornithology," says Waterton, "to see thousands of aras flying over your head, low enough to let you have a full view of their flaming mantle." How delightful would it have been, on some bright and dewy morning, to have accompanied Lord Anson to view a magnificent rapid in the island of Quibo. A fine river of transparent water there precipitates itself along a rocky channel, forming numerous falls, and the great disrupted rocks which form its boundary on either side are crowned with lofty forest trees. "While the commodore and those who were with him attentively viewing the place, were remarking the different blendings of the waters, the rocks, and the woods, there came in sight as it were still more to heighten and animate the prospect, a prodigious flight of maccaws, which hovering over this spot, and often whirling and playing on the wing about it, afforded a most brilliant appearance by the glittering of the sun upon their varied plumage; so that some of the spectators cannot refrain from a kind of transport when they recount the complicated beauties which occurred at this extraordinary water-fall." The blue and yellow species (*P. ararauna*, Linn.) is little inferior to the preceding, either in size or sumptuousness. It is less common, and seems to have been first described by Aldrovandus, from a specimen which he saw in the palace of the Duke of Mantua. It is said to be also less easily reclaimed as a domestic bird,—yet we have not seldom enjoyed the society of a very fine example which makes its way familiarly (such is its custom in the afternoon) amid the varied horticultural produce which graces the *dessert* of Dr Neill. Many other splendid species are described and figured in the works of naturalists.

In the genus ARATINGA of Spix, the bill is slender, dentated; the orbits of the eyes naked, the cheeks rarely so; the tail lengthened, wedge-shaped, the intermediate feathers prolonged. The species are peculiar to the new world. Such are *Ar. Carolinæ-Augustæ*, *chrysocephalus*, &c. To these the genus PSITTACARA of Vigors seems allied, the bill, however, being shorter and stouter, and

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[1] The most complete and scientific treatises with which we are acquainted on the parrot tribe are,—*Conspectus Psittacorum*, ab H. Kuhl, Ph. Dr. &c. in *Nova Acta Acad. Nat. Cur.* tom. x. p. 1; and Wagler's *Monographia Psittacorum*.

the upper mandible compressed at the tip. The head is feathered, but the orbits are naked. The species, such as *P. squamosus*, &c. are likewise natives of South America.

The genus PALÆORNIS of Vigors has the bill rather thick, the culmen of the upper mandible rounded, the lower broad, short, emarginate. The middle feathers of the tail are greatly lengthened. The most anciently known of the parrot race belong to this genus, such as the Alexandrine parrakeet, and other long-tailed species, distinguished by their elegance of form, their ruby-coloured bills, their semicircled necks, and the rich *verdure* of their plumage. The one just named is native to India and Ceylon, and derives its designation from the fact, real or supposed, of its having been first transported from Asiatic countries by Alexander the Great. Its most distinguishing characters consist in the broad black patch which occupies the fore-part of the throat, and extends laterally in two narrow processes on each side of the neck; a black line stretches from the base of the beak to the eyes, and there is a deep purplish-red patch at the base of the wings. Its bill is larger than that of the rose-coloured parrakeet (*P. torquatus*), which, however, it greatly resembles in its general aspect. The last-named species is widely spread over India, and as far eastward as Manilla. It appears, indeed, to be identical with another species extremely abundant on the African coasts, and well known in France under the title of *perruche de Senegal.* In so far as any conclusion can be drawn from the vague and brief descriptions handed down by ancient writers, it would appear that this species was, as it still continues to be, more frequent in the days of antiquity than any of its congeners. No allusion is made by these authors to those specific marks by which the Alexandrine parrakeet is so clearly distinguished, and the general description applies very closely to the rose-necked kind. That the latter was extensively known, and held in high esteem on account of the brilliancy of its plumage, the docility of its manners, and its successful imitative powers, is proved by innumerable passages in the classical writers of antiquity, more especially from the earliest times of the Roman empire, to a very late period of its annals.[1] The Alexandrine parrot is generally supposed to have been brought to Europe from the island of Ceylon, the ancient Taprobane. In the reign of Nero, the Romans introduced other species from different quarters of Africa.[2] They were highly prized by that luxurious people, who lodged them in superb cages of silver, ivory, and tortoise-shell; and the price of a parrot in those days frequently exceeded that of a slave.[3] Nor did Ovid think it beneath him to write a lengthened elegy on the death of Corinna's favourite,—a bird which, in the love it bore its mistress, seems to have emulated that of the dying Greek for his country:—

Clamavit moriens lingua, Corinna, Vale.[4]

In the same group is generally included that beautiful and richly varied species from the Molucca Islands, called the blue-bellied parrakeet, *Ps. cyanogaster*, Shaw. Its tongue, in common with that of several New Holland parrakeets, is finely ciliated at the tip on either side. Hence the formation in their favour of Mr Vigors's genus TRICHOGLOSSUS. Vailliant, during his residence at the Cape, had an opportunity of studying the manners of a pair of the species just named, which had been imported from Amboyna. They bred during their confinement in the menagerie of M. Van Bletemberg, then governor of the Cape. The female deplumed her beautiful breast, and after having collected the feathers into a heap, deposited two round white eggs, on which she sat most assiduously, the male feeding her at intervals, by disinterestedly disgorging what he had swallowed, and presenting the same to his spouse. The young were produced at the end of nineteen days, and in the space of a few more became covered with a gray cinereous down, which was by degrees succeeded by green feathers on the body, and by blue ones on the head. At the end of three weeks they left the nest, and perched upon the neighbouring sticks, where the male and female fed them in concert, as above described, after the manner of pigeons. The parent birds continued to tend them in this manner for six months, and often afforded a very interesting scene,—the young being frequently seated beyond the female, and the male not being able to *reach* them, first presented the food to his mate, who immediately delivered it to her young. These, though of different sexes, were perfectly alike till the first moulting, at which time red feathers bordered with green began to appear upon the breast, and the male became distinguished by the blue patch upon the abdomen.[5]

In the genus PLATYCERCUS, Vigors, the tail is broad, depressed, and somewhat rounded. The species inhabit New Holland, and the islands of the South Pacific and Indian Oceans. Examples *Pl. Pennantii, Tabuensis*, &c.

Among the *perruches ordinaires* of Cuvier (a portion of the genus CONURUS, Kuhl), distinguished by a regularly graduated tail, without any disproportionate prolongation of the central feathers, we have the Carolina parrot of Wilson (*Ps. Carolinensis*, Linn.), a green plumaged bird, with yellow head and neck, the forehead and cheeks orange. Of more than two hundred species now known to belong to the parrot tribe, this is the only one which inhabits the United States, where it is chiefly restricted to the warmer portions,—venturing but rarely beyond Virginia. West of the Alleghanies, however, circumstances induce it to visit much higher latitudes,—so that, following the great valley of the Mississippi, it is seen to frequent the banks of the Illinois, and occasionally to approach the southern shores of Lake Michigan. Straggling parties have even been sometimes observed in the valley of the Juniata, in Pennsylvania; and a flock, to the great surprise of the Dutch inhabitants of Albany, are said to have appeared in that vicinity. This species constantly inhabits and breeds in the southern states, and is so far hardy as to make its appearance, commonly in the depth of winter, along the woody banks of the Ohio, the interior of Alabama, and the banks of the Mississippi and Missouri around St Louis and other places, when nearly all other southern birds have migrated

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[1] Ancient writers are unanimous in their statements that parrots came to us first of all from India. Aristotle calls the Psittacus "το ινδικον ορνεον;" and Arrian also makes it a native of the East (*Hist. Ind.* cap. xv.). The parrots of Africa became first known to the Romans in the time of Nero. (Plin. *Nat. Hist.* lib. vi. c. 29.) For the classical history of these birds, see Mr Vigors's "Sketches in Ornithology,"—*Zoological Journal*, vol. ii. p. 37.

[2] See *Zoological Gardens*, vol. ii. p. 96.

[3] The splendour of a parrot's cage is thus described by Statius:—

At tibi quanta domus, rutila testudine fulgens,
Connexusque ebori virgarum argenteus ordo,
Argutumque tuo stridentia limina cornu,
Et querulæ jam sponte fores: vacat ille beatus
Carcer.—*Sylv.* lib. ii.

[4] *Edinburgh Cabinet Library*, Africa, p. 480.

[5] Shaw's *General Zoology*, vol. viii. p. 414.

before the storms of that inclement season.[1] We may judge of the abundance of this species, even up to a recent period, from the statement of Vaillant, who assures us that he saw a package containing above 6000 skins, which had been sent to a *plumassier* at Paris, for the formation of ornamental dresses.[2] Mr Audubon, however, informs us that their numbers are now rapidly diminishing, and that in some districts where, twenty-five years ago, they were plentiful, scarcely one is to be seen. "I should think," he adds, "that along the Mississippi there is not now half the number that existed fifteen years ago." With a view to illustrate the natural habits of these birds, we extract the following account from the work of an English gentleman now settled in America. "The Carolina parrakeets in all their movements, which are uniformly gregarious, show a peculiar predilection for the alluvial, rich, and dark forests bordering the principal rivers and larger streams, in which the towering cypress[3] and gigantic sycamore[4] spread their vast summits, or stretch their innumerable arms, over a wide waste of moving or stagnant waters. From these, the beech, and the hack-berry,[5] they derive an important supply of food. The flocks, moving in the manner of wild pigeons, dart in swift and airy phalanx through the green boughs of the forest; screaming in a general concert, they wheel in wide and descending circles round the tall button-wood, and all alight in the same instant, their green lustre, like the fairy mantle, rendering them nearly invisible beneath the shady branches, where they sit, perhaps arranging their plumage, and, shuffling side by side, seem to caress and scratch each other's heads with all the fondness and unvarying friendship of affectionate doves. If the gun thin their ranks, they hover over the screaming, wounded, or dying, and returning and flying around the place where they miss their companions, in their sympathy seem to lose all idea of impending danger. More fortunate in their excursions, they next proceed to gratify the calls of hunger, and descend to the banks of the river or the neighbouring fields in quest of the inviting kernels of the cockle burr,[6] and probably of the bitter weed,[7] which they extract from their husks with great dexterity. In the depth of winter, when other resources begin to fail, they, in common with the yellow-bird and some other finches, assemble among the tall sycamores,[8] and, hanging from the extreme twigs, in the most airy and graceful postures, scatter around them a cloud of down from the pendant balls, in quest of the seeds which now afford them an ample repast. With that peculiar caprice, or perhaps appetite, which characterizes them, they are also observed to frequent the saline springs or *licks*, to gratify their uncommon taste for salt. Out of mere wantonness, they often frequent the orchards, and appear delighted with the fruitless frolic of plucking apples from the trees, and strewing them on the ground untasted. So common is this practice among them in Arkansas territory, that no apples are ever suffered to ripen. They are also fond of some sorts of berries, and particularly of mulberries, which they eat piecemeal in their usual manner, as they hold them by the foot. According to Audubon, they likewise attack the outstanding stacks of grain in flocks, committing great waste; and on these occasions, as well as the former, they are so bold or incautious as readily to become the prey of the sportsman in great numbers. Peculiarity of food appears wholly to influence the visits and residence of this bird, and in plain, champaign, or mountainous countries, they are wholly strangers, though common along the banks of all the intermediate water-courses and lagoons.

"Of their manners at the interesting period of propagation and incubation we are not yet satisfactorily informed. They nest in hollow trees, and take little if any pains to provide more than a simple hollow in which to lay their eggs, like the woodpeckers. Several females deposit their eggs in the same cavity; the number laid by each is said to be only three, which are nearly round, and of a light-greenish white.[9] They are at all times particularly attached to the large sycamores, in the hollow trunks of which they roost in close community, and enter at the same aperture, into which they climb. They are said to cling close to the sides of the tree, holding fast by the claws and bill; and into these hollows they often retire during the day, either in very warm or inclement weather, to sleep or pass away the time in indolent and social security, like the *Rupicolas*[10] of the Peruvian caves, at length only hastily aroused to forage at the calls of hunger. Indeed, from the swiftness and celerity of their aërial movements, darting through the gleaming sunshine, like so many sylvan cherubs, decked in green and gold, it is obvious that their actions as well as their manners are not calculated for any long endurance, and, shy and retiring from all society but that to which they are inseparably wedded, they rove abroad with incessant activity, until their wants are gratified, when, hid from sight, they again relapse into that indolence which seems a relief to their exertions."[11]

The pavouan parrakeet (*Ps. Guianensis*, Lath.) belongs to our present group. This species is native to Cayenne, and the Antilles, where it is not uncommon, often flying about in flocks, frequenting the wooded savannahs, and feeding by preference on the berries of *Erythrina corallodendron*. Its length is about twelve inches, its prevailing plumage green, the cheeks and sides of the neck being speckled with bright red, which becomes more conspicuous as the bird advances in age; the smaller wing-coverts are bright red, the greater yellow, and both the quill and tail feathers are dusky yellow beneath. The bill is whitish, the legs and feet gray. We owe to M. Gabriac the following interesting particulars regarding the breeding of a pair of this species in the domestic state. Two cages were prepared for their reception in the month of April. They were placed contiguous, but communicating only by a small door, and the one enjoyed the "blessed light of day," while the other was kept covered, so that no light could enter but by the mutual door. The latter also contained an abundant supply of saw-dust. The birds were placed in the open apartment, which was the larger of the two, and they speedily showed symptoms of tender attachment to each other. They long declined, however, to enter the darkened dwelling, although the female put in her head, withdrew it again, advanced part of her body, then returned tail foremost,—but finally, after several days of hesitation, she entered the mysterious chamber. There she expressed her satisfaction by little kindly cheerful cries, and often called in the male, who exhibited every proof of affection. She soon began to scrape about, and arrange a kind of nest, and on the 18th of May she layed her first egg, succeeded at intervals of three days by a second, third, and fourth,—after which she sat assiduously. The male took no share in the hatching, but he kept constantly close by the nest, as if to cheer her sedentary hours. He did not however allow his affection to his wife to interfere with his duty to his hoped-for family. If the female, who never left the nest but to solace herself with meat and drink, appeared to devote too much time to that indulgence, he remanded her back by a little blow with his

1 Nuttall's *American Ornithology*, vol. i. p. 546.
2 *Hist. Nat. des Perroquets.*
3 *Cupressus disticha.*
4 *Platanus occidentalis.*
5 *Celtis occidentalis.*
6 *Xanthium strumarium.*
7 *Ambrosia, species.*
8 *Platanus occidentalis.*
9 Audubon, *Orn. Biog.* i. p. 139.
10 *Cock of the rock* of Peru, which is also somewhat related, apparently, to the parrots. (Note by Mr Nuttall.)
11 Nuttall's *Manual of Ornithology*, i. 456.

Scansores.

beak, which occasionally produced something approaching to a quarrel. At the termination of twenty-five days, there being no appearance of progeny, the eggs were purposely withdrawn and broken, and were found to contain young in different stages of development, but all dead. This result was attributed to stormy weather, which had prevailed during incubation. Fortunately a second laying, accompanied by the same circumstances as the first, commenced on the 14th of July, and after twenty-three days, counted rigorously, the young appeared from each egg in a succession corresponding to the order of laying. They were at first covered by a grayish down, and were cherished with the tenderest solicitude by the parents, who on the approach of any threatened danger defended them with the greatest courage. It was in truth a curious sight to see two creatures before so kind and tenderly affectionate to those around them, so grateful for their food, and so solicitous of human kindness, converted by the strength of this new passion into little tigers, and so intractable as to attend no longer to fair hands or gentle voices. This natural wildness showed itself also strongly in the young ones, who recognised alone their parents, and bit and scratched at all the world besides.

A few species have the tail square, with the central feathers prolonged, and these in *Ps. setarius*, Temm. *Pl. Col.* 15, are bare of barbs, except at the tip.

The great mass of *parrots* properly so called, belonging to the restricted genus PSITTACUS, have the bill rather strong, the face clothed with feathers, the head large, without crest, the body thick, and the tail rather short and square. Green is the prevailing colour of the plumage, and the species are native to various countries both of the old world and the new. One of the best known, and most remarkable for its easy docility, the distinctness of its articulation, and general loquacious powers, is the common gray parrot, *Ps. erythacus*, of which the tail is red, and the orbits white and naked. It is an African species, and one of the earliest and most frequently imported. It has been known to breed in Europe,—a French gentleman at Marmande having had a pair which produced young ones for five or six years successively. They made their nest in spring, in a cask filled with saw-dust, the number of eggs being four, of which one was always unproductive. According to Labat a similar instance had previously occurred at Paris. Our present square-tailed group is very numerous.

The lories (genus LORIUS, Vig.) have the bill rather attenuated, the upper mandible much arched, compressed, the lower lengthened, and nearly entire. The tongue is described as bristly and tubular. The tail is rather short, slightly graduated. Various shades of red form the prevailing colour of the plumage. The species inhabit the East Indies and the Asiatic islands. Example, *Ps. unicolor, garrulus*, &c.

Certain short-tailed species, of small size, which inhabit the tropical countries of both the new and old world, form the genus PSITTACULUS of Kuhl. Such are *Ps. passerinus, ui*, &c. They are erroneously called parrakeets by some of our English writers, a name which would confound them with the long-tailed species already alluded to, and more generally recognised under that title. The vast extent of the parrot tribe renders subdivision extremely desirable as a matter of convenience; but it must be confessed that a mere difference in size and colour is not of itself sufficient to authorize the separation of groups, or the formation of genera.

The genus MICROGLOSSUS, Vieil., is, however, better founded. The bill, especially the upper mandible, is very large and strong, the head ornamented by a crest of narrow feathers, and the face naked. The tongue is cylindrical, lengthened, and tubular, capable of being greatly protruded from the mouth, and ending in a kind of corneous gland, cloven at the tip. (See Plate CCCXCVII. figs. 5 and 6.) The legs are more naked than usual, and the tarsi, on which they occasionally rest while walking, very short and square. The tail is square or even. We are not acquainted with more than two species, both from eastern countries. The black or giant cockatoo (*Ps. gigas*), called by old Edwards "a parrot of the first magnitude," and *Ps. aterrimus* of Gmelin, are the birds alluded to. Their synonymy seems confused. They inhabit New Guinea and the isle of Waigiou; and Edwards's figure was taken from a living specimen in Ceylon, but whether indigenous or imported does not appear. Vaillant observes of one of the species (his *ara noir à trompe*), that in cold weather it covered the bare space on each side of its face by lowering over them the feathers of the crest.

The great New Holland species, called the Banksian cockatoo, discovered in the course of Captain Cook's first circumnavigation, forms, with others, the modern genus *Calyptorhynchus*. (Plate CCCXCVII. fig. 2.) These large dark-coloured species are as yet but ill defined. They are said to live on roots; but Mr Bennet alludes to one which feeds on the larvæ of insects, as well as on the seeds of Banksia, Hakea, and even of Xanthorrhœa, or grass tree; and in the travels of that gentleman we find the following passage, which relates to a certain locality in New Holland. "Black and white cockatoos had lately become very numerous about this part of the country: the former appeared to have been attracted by some trees that had been felled when clearing a spot of land for cultivation,—as these birds visit the dead or fallen trees to procure the larvæ of insects that breed in them. I have seen, more than once, small trees lying prostrate, occasioned by the powerful bills of the large black cockatoos, who, observing on the trunk, externally, indications of a larva being within, have diligently laboured to extract it; and should the object of their search be situated (as often occurs) far in, before they reach it the trunk is so much cut through, that the slightest puff of wind lays it prostrate."[1]

The white-plumaged cockatoos, with conspicuous crests, tinged in part with orange, red, or yellow, pertain to the genus PLYCTOLOPHUS, Vieil. (Plate CCCXCVII. fig. 3.) They inhabit New Holland and the eastern islands, and are remarkable for their great docility. They are said to prefer the vicinity of marshy places.

A beautiful small parrot, with longer legs than usual, and straighter claws, forms the genus PEZOPORUS, Illiger. It is green and yellow, spotted with black, the frontlet red, the tail long and graduated. The outer hind claw is very long. This singular bird, commonly called the ground parrot (*P. terrestris*, Shaw,—*P. formosus*, Latham), differs from its congeners in hardly ever perching upon trees. It remains upon the ground in sedgy plains, or runs among the long grass, almost after the manner of a rail. (Plate CCCXCVII. fig. 4.)

At the conclusion of the scansorial order Cuvier has placed two genera which have certainly but little in common with the preceding groups, and which some consider as allied to the gallinaceous order, while others have placed them in the conirostral tribe of Passeres,—we mean CORYTHAIX and MUSOPHAGA. In both the bill is rather short, the upper mandible bulged or rounded, the feet have a short membrane between the toes, and although these are not placed exactly in pairs, yet the outer toe is versatile to a considerable degree. The nostrils are simply pierced in the corneous portion of the bill, the margins of which are dentated. In the plantain-eaters (genus MUSOPHAGA,

[1] *Wanderings in New South Wales*, &c. i. 182.

Rasores.

Isert, Plate CCCXCVII. fig. 8) the base of the bill forms a raised, expanded disk upon the forehead. The violet plantain-eater (*M. violacea*) is a bird of great beauty, the general plumage being of a rich glossy violet black, the crown and primaries crimson, the bill yellow tipt with red, and a clear white stripe beneath the eye. It occurs in the province of Acra, in Guinea, and in other parts of Western Africa, and feeds on the fruit of the musa or plantain tree. The touracos (genus CORYTHAIX, Illiger, Plate CCCXCVII. fig. 7) want the expansion at the base of the bill, and have the head adorned by an elongated crest. Several beautiful species belong to this genus, such as the *Cuculus Persa* of Linn., a native of the Cape,—of a fine green colour, with a portion of the quill-feathers crimson. Vaillant informs us that there are great numbers of these birds in the country of the Kottinquas,—that they are very difficult to shoot, as they perch only on the summits of the tallest trees, and rarely suffer any one to approach within gun-shot,—but that they are easily caught alive in snares baited with such fruits as are in season. He adds, that they are excellent eating. Another species of this genus, which it is delightful to look upon, is the Pauline touraco, *C. Paulina*, also a native of Southern Africa. M. Vieillot, who had occasion to examine one alive in Paris, informs us that its manners were mild and familiar, that it lived on succulent fruits, and was fond of sugar. Its habits were active, its voice sonorous, and apparently ventriloqual.

ORDER IV.—RASORES.[1]

GALLINACEOUS OR RASORIAL BIRDS.

The species of this order, by far the most valuable to the human race of all the feathered tribes (how many, regardless of Ornithology, yet dwell with pleasure on a roast-ed turkey), are characterized by a rather short and convex bill. The upper mandible is somewhat curved, and furnished with a cere, sometimes naked, sometimes feathered. The head is generally small in proportion to the body. The nostrils are placed on each side of the bill, and usually in a fleshy protecting membrane. The tarsi are for the most part elongated. The toes are four in number, three of which are anterior, and united by a membrane more or less extended, at their bases; the fourth, posterior, is articulated higher than the others, and is in some cases very small, or even entirely wanting.

This order, as we have elsewhere noticed, contains several of the most ornamental, and a great majority of the most highly prized and useful species of the feathered race. While the peacock and golden pheasant stand unrivalled alike for elegance of form and beauty of plumage, the turkey and domestic fowl, the grouse quail and partridge, lay claim to more substantial though less sentimental regard, as conducing in no small degree to the social enjoyments of civilized life. Gallinaceous birds are generally distinguished by a bulky form, and a heavy and somewhat laborious flight. In fact, the sternum or breast-bone is so deeply notched on either side as to diminish the support afforded to the action of the pectoral muscles; and the power of the wings, and consequent duration and velocity of their movements, suffer a corresponding diminution.

With the exception of the alectors or curassoes, few of the gallinaceous species build on trees (in which they differ remarkably from the preceding orders), though all delight in basking on the ground, and scraping in the dry and sultry soil, for which purpose they are provided with muscular limbs and feet. They live upon all sorts of grain and seeds,—occasionally upon berries, or the buds of shrubs and trees,—and, the younger birds especially, show themselves sufficiently eager and expert in the capture of insect prey. The females lay a great number of eggs, in a rude and carelessly constructed nest; and the newly-produced offspring, unlike the callow nestlings of the other orders, though they remain for some time associated with their parents, run swiftly, and pick freely from their first exclusion. The males, particularly towards the breeding season, are quarrelsome and courageous,—indulging in frequent and sometimes fatal contention. They are often furnished with spurs. In the satyr pheasant both sexes are so armed, and the males are moreover provided with a couple of horns. In the polyplectron the tarsi of the male are doubly armed, there being two spurs on each leg.

In their general form and habits, the particular structure and functions of the digestive system, and the great benefits which they confer upon the human race, birds of this order have been observed to bear a considerable resemblance to the ruminating or herbivorous quadrupeds. Like these, their stomach is of a more complex character, consisting of a dilated membranous pouch or crop, and a muscular gizzard,—in the former of which their food is rendered moist and pulpy, in the latter it is bruised and broken, and otherwise prepared for the production of the life-sustaining chyle; whereas in accipitrine birds the crop is either inconspicuous or non-existent, and the stomach, if not membranous, at least has its muscular coating very thin. The intestine in gallinaceous birds is rather long and wide, of nearly uniform diameter, and provided with two enormous cæca. Their flesh, we need scarcely say, is very delicate, and highly esteemed as a pleasing and nutritious food. It varies considerably in colour,—that of the turkey and common poultry being white, of the moor grouse brownish red, while the breast of the black-cock presents two distinct layers of red and white, the one imposed upon the other. We allude at present to its *culinary* aspect.

Naturalists have erred in assigning the polygamous habit as a general characteristic of our present order The instinct to pair, or habit of monogamy, is no doubt bestowed only on those species to which it is necessary for the sustentation of their young, and differs considerably in the nature and permanence of the attachment, according as the nest is placed above or upon the surface of the ground. All birds which build on trees, as was long ago observed by Lord Kames, are hatched blind, or extremely defective in the sense of sight, and almost without feathers,—thus requiring the sedulous care of both parents. But the generality even of gallinaceous birds, which breed upon the ground, do likewise pair, though the hatching of the eggs is entirely confided to the female, who completes her task by leading the young towards their proper food, which they are able to select for themselves, being active, completely formed, and well feathered, from their first exclusion. What is indeed more beautiful than the fond affection of these devoted creatures, teaching in the blindness of instinctive love, a lesson to proud but cold humanity? Who knoweth not (now divinely told) how the hen "doth gather her brood beneath her wings;" how she shelters them from the nipping blast, expanding her downy breast and feathery pinions, till she becomes a populous tabernacle, a living temple of maternal love, beset with small protruding bills, and bright but gentle eyes; how she will dare, with upraised ruffled plumes, the fiercest onset of the direst foe,—the callous school-boy with his threatening club, the snarling cur-dog with his ivory fangs, the insidious weasel, creeping serpent-like through tangled herbage, or the bolder bird of prey, "lord of the lion

[1] GALLINÆ, Linn.

heart and eagle eye," descending swift and sure, like thunder-bolt from heaven! What are each or all of these in dread array, with death itself, to her at other times a fearful creature, but now pervaded by the deep intensity of mother love? Who knoweth not these things may have wandered far through wood and wilderness, up vast and lonely mountains, in moist and green savannahs, o'er dry and desert sands,—but he has never turned a kindly and considerate eye towards perhaps the too familiar features of some lowly farm-stead close by his early home. Yet to such thoughts the mind, in those that loved them once, not seldom turns. The hoary worn-out warrior, with "scars entrenched," and decked with emblems of the blood-stained field,—the smooth but hollow statesman, gorgeous on gala days in regal throngs,—the lawyer with insidious tongue, by which the worse is made the better reason,—the nabob "with visage discomposed," sallow as his gold (his heart as pure?),—the soft physician, with stilly foot and ever ready palm,—the merchant prince dreaming of "Tyre and Sidon," of freighted vessels, and "the injurious sea,"—think they not often of their boyish years, when one bright summer day seemed like a century of such delight as all their best planned schemes of proud ambition since then have yielded never? But in these fantastic thoughts forget we not our *gallinaceous order?*

The male, though somewhat less assiduous than the female, continues to manifest a certain degree of parental solicitude, by uttering the alarm note on the approach of birds of prey, or other dangerous foes. Black game and wood grouse, however, do not seem to pair at all, but in the genial spring a male assembles round him a certain number of devoted females, which afterwards deposit their eggs, and rear their young altogether independent of the male parent. These birds are therefore polygamous in the proper acceptation of the term. Indeed, even among herbivorous quadrupeds pairing is rare, because the female can suckle her young while she herself is feeding;—but the monogamous habit probably obtains among most carnivorous quadrupeds, and certainly among all carnivorous birds, because incubation leaves the female no sufficient time to hunt for food,[1] and because young birds cannot bear a long fast, and therefore require the assistance of both parents while unable to provide for themselves.

An extraordinary circumstance has been observed in the females of certain genera of this order, viz. an assumption of the male plumage after a certain period of life. We believe it to be a fact in the natural history of common poultry, that all hen-birds which either by accident or design have been allowed to attain the age of sixteen years complete, have been observed to assume the plumage of cocks! The same change has been seen to take place both in the female pheasant and the pea-hen, but at more indeterminate periods of life, and less in connection with an advanced age. Though these facts have not escaped the observation of the philosophical naturalist, yet the different circumstances attending their occurrence have not been detailed with sufficient frequency or fulness to admit of any satisfactory theory being offered in their explanation.[2] We shall conclude these general remarks by observing, that the gallinaceous order, with the exception of the pigeon tribe, and the genus *Opisthocomus* (*l'haozin*, Buffon), which certainly offer some very anomalous characters, is naturally and consistently composed. We shall now proceed to a brief notice of the principal genera.

The birds known by the general name of *Alectors* are species of large size from South America, somewhat allied to turkeys. Their tails are broad and rounded, and composed of large stiff feathers. They inhabit woods, living on fruits and buds, perching and building their nests on trees, and dwelling gregariously in love and amity. They are known under the by no means euphonious names of *hoccos* and *jacous* (words which we shall not pronounce except when necessary), and are arranged as follows by Baron Cuvier. The hoccos properly so called, which are also known as curassoes (genus CRAX, Linn., Plate CCCXCVIII. fig. 1), have the bill strong, and its base surrounded by a skin sometimes of lively colour, and containing the nostrils. The head is ornamented by a tuft of long, narrow, recurved feathers. The most common kind is the *Crax alector*, or crested curasso, which was at one time almost completely acclimated in Holland, where they were as prolific as common poultry. It is so frequent in the woods of Guiana as to form, according to M. Sonnini, the surest resource of every hungry traveller whose stock of provisions may be found exhausted, and who has therefore become dependent on his gun. They are gregarious, and even when a considerable number have been shot, the rest will remain quietly perched, as if unconscious of the surrounding slaughter. Several other species are described in systematic works. *C. globicera* is distinguished by a large rounded tubercle on the base of the upper mandible.

In the genus OURAX, Cuv., the bill is shorter and thicker, with its basal membrane, as well as the greater portion of the head, covered with short, velvety feathers. (Plate CCCXCVIII. fig. 2.) Here is placed the *Ourax pauxi* (*Crax pauxi*, Linn.), or galeated curasso, a large turkey-like bird, with plumage of a shining black with green reflections, the abdomen and under tail-coverts white. At the base of the beak is a great oval tubercle, of a pale blue colour, and as hard as stone. The structure or position of the windpipe is peculiar. "Sa trachée," says Cuvier, "descend dehors, le long du côté droit jusqu'en arrière du sternum, se recourbe vers le côté gauche, et revient en avant pour rentrer dans la poitrine par la fourchette. Tous ces anneaux sont comprimés." This species is a native of Mexico, where it lives gregariously, perching on trees, but building usually on the ground, and leading about its young after the manner of the pheasant and common hen. It is easily domesticated.

The guans or yacous, genus PENELOPE of Merrem, have the bill more slender than the preceding, with a bare space around the eye, and on the lower part of the throat,—the latter generally capable of inflation. The individuals of the same species seem to vary considerably, so that many doubtful kinds have been described by naturalists. The guan, commonly so called (*Pen. cristata*, Gmelin), is the largest of the genus, measuring about thirty inches in total length. The whole upper surface of the body is of a dusky black or bronze colour, glossed with green and olive. The feathers on the back of the head form a thick erectile crest. The fore part of the neck and breast are spotted with white, each feather being surrounded by a white border. The naked part of the throat is bright scarlet, with a depending fold of the same colour. The manners of this bird resemble those of the curassoes. They search for food along the ground, but perch and build upon the tops of trees. They are less gregarious, generally keeping together in pairs, and remarkable, it is said, for the strictest constancy, and their strong attachment to each other,—being thus deserving of the name they bear, that of the devoted consort of Ulysses.

The genus ORTILDA of Merrem scarcely differs from the preceding, except in having a much smaller portion bare around the eye and throat. We are acquainted with only a single species, the *Phasianus motmot* of Gmelin (*Phas. parragua*, Lath.). Its voice is very strong, and the windpipe descends beneath the skin towards the abdomen, and then remounts into the chest. The plumage is of a bronzed

[1] See Kames's *Sketches*.

[2] Wilson's *Illustrations of Zoology*, vol. i. Order GALLINÆ.

brown above, and ashy-white below, the crest red. It inhabits Brazil, Paraguay, and Guiana. Two other species are described by M. Lesson, *Ort. Goudotii* and *squamata*,—the former inhabits the mountains of Santa Fé de Bogota, the latter is native to Brazil.[1]

The genus Opisthocomus of Hoffmansegg (*Sasa* of Vieil.) is associated in our present system with the preceding alectors. The only known species (*Phasianus cristatus*, Lath.) has the bill short and thick, the nostrils pierced in its corneous portion, without the usual surrounding membrane. The head bears a crest of long, slender, decomposed feathers, and the toes (in which character it also differs from all the genuine gallinaceous kind) have no connecting membrane at the base. The bird occurs in Guiana, where it is usually seen perched in places subject to inundation. It lives chiefly on the leaves and seeds of a species of arum. Its flesh has a strong smell of castoreum, and is used only as a bait for fishes. "Il forme," says Baron Cuvier, "un genre très distinct des autres gallinacées, et qui pourra devenir le type d'un famille particulière quand on connaitra son anatomie."[2] Its true situation in the natural system seems at present quite uncertain, but, from its great diversity in different works, must assuredly in some be most erroneous.

In the genus Pavo of Linn., the bill, of moderate size, is bare at the base, the nostrils lateral, sub-basal, open. The head is crested, the cheeks are naked, or nearly so. The tarsi are rather long, and armed with a conical spur. The upper coverts of the tail are of singular length and magnificence. The tail itself is crectile and wedge-shaped. The wings are rather short. This genus, as now restricted, contains only two species. The common peacock (*Pavo cristatus*, Linn.), so much admired for the surpassing splendour of its plumage, and now so familiarly known as a domestic bird, has probably been reduced to a state of dependence, if not of servitude, for some thousand years. The earliest notice we possess of it is contained in the second book of Chronicles. "For the king's ships went to Tarshish with the servants of Hiram: every three years once came the ships of Tarshish, bringing gold, and silver, ivory, and apes, and peacocks." The introduction of this beautiful bird to the western countries of Europe has never been clearly traced,—but every step of its progress has no doubt been owing rather to the agency of man than the instinct of nature. Its inborn tendency would clearly have been to return to whence it came,—to seek again the perpetual sunshine, and ever-verdant forests of Asia, the banks "of Ganges or Hydaspes, Indian streams." It appears to have been unknown even in Greece during the early manhood of Alexander the Great, by whom it was first observed with no less wonder than delight in the progress of his southern expedition, and then transmitted to his native country. There, however, it must have multiplied speedily, as Aristotle, who died in a year or two after "the great Emathian conqueror," mentions the peacock as a well-known bird. It is now distributed among most civilized nations, beautifying with lustrous train our verdant lawns, and arching its proud emblazoned neck among the "ancestral trees" of many lordly dwellings. The cry of the peacock, unless when mellowed by distance, is harsh and unmusical, but extends far and wide. Indeed the notes of all birds, whether musically toned or inharmonious, are very clear and forcible. The voice of a blackbird may be heard as far as that of a man,—the clanging cry of the stork has been calculated to fill a circumference of nearly half a league, and the harsh scream of the peacock extends as far as that of an elephant.[3] Mr Waterton observes, that the singular metallic note of the campanero or bell-bird of America is audible from a distance of three miles.

The only other species of this genus (as now restricted) is the Japan or Javanese peacock (*P. Japonensis*, Briss.,—*P. Javanicus*, Horsfield), of which we have elsewhere figured both the adult male and young, under the name of Aldrovandine peacock, from the specimens in the Edinburgh Museum.[4] It occurs in Japan, Java, and other eastern and southern regions of Asia. The particular markings and general distribution of the colours in the train scarcely differ from those of the better-known species; but the Aldrovandine bird may be distinguished at first sight from the common kind, by a difference in the form, colour, and consistence of the cervical feathers; by the shape and structure of the occipital crest, of which the plumes are lance-shaped, or broadly linear, and barbed throughout their entire length, instead of being merely tufted at the extremities; by the dissimilar plumage of the wing-coverts, and the number of feathers in the tail, which in the former consists of twenty, in the latter of only eighteen.

The genus Polyplectron, Temm., contains a few species formerly classed with the preceding, but of smaller size, and distinguished by a pair of spurs on each tarsus. Such is the beautiful Thibet peacock (*Pol. Thibetanus*), the peacock-pheasant of Edwards, of which a great proportion of the plumage is ornamented by large and very brilliant spots of greenish blue, changing with the varying light to gold and purple, and surrounded by circles of black and yellowish white. The male is about the size of the golden pheasant. The plumage of the female is less brilliant, and her tail shorter. The colour in the young of both sexes is earthy gray, with large spots and small lines of brown. This species is of easy domestication, and not remarkable for shyness even in a state of nature. It is native to the mountains of Thibet, and is said also to occur in China. At least it is frequent in the aviaries of that leaf-soaking people.

The genus Lophophorus, Temm., distinguished by its tufted hanging crest, and strongly bent and broadly margined bill, contains that splendid bird the Impeyan pheasant (*Loph. refulgens*), of which the colours of the plumage are so exceedingly brilliant from their metallic lustre, and so variable according to the direction of the light or the position of the spectator, that they cannot be expressed by words, and even the skill of the most accomplished painter would in vain attempt to equal the bright original. Purple, green, and gold, are the prevailing hues. The female, however, is almost entirely destitute of metallic splendour. This bird inhabits the mountains in the northern parts of Hindustan. Lady Impey endeavoured to transport it alive to England, but it died on the passage. It is known to the natives by the name of *monaul*, which signifies the bird of gold.

The genus Meleagris, Linn., distinguished by its bare and wattled head and neck, and broad erectile tail, contains the valuable but unromantic turkey, *M. gallo-pavo*, Linn., a heavy and ungraceful bird, as it exists in the poultry-yards of Britain, but of a richer plumage and more powerful wing in its native wooded wilderness. "The wild turkey," observes Mr Nuttall, "once prevalent throughout

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1 *Dictionnaire des Sciences Nat.* t. lix. p. 195.

2 *Règne Animal*, t. i. p. 473, note.

3 We have few opportunities (fortunately) afforded us in this country of judging of the strength of voice in wild beasts. Our own experience extends only to the following homely fact, which, however, it may be worth while to mention. During the residence in Edinburgh of Mr Wombwell's and other travelling menageries, we have endeavoured to test the extension of the lion's voice from different quarters. We have often heard it very distinctly on a still evening, about feeding time, from the top of Craigleith quarry, distant from the menagerie (on the Mound, Princes Street) about two miles and a half.

4 *Illustrations of Zoology*, vol. i. pl. 14, 15.

the whole continent of North America, from Mexico and the Antilles to the forests of Lower Canada, is now, by the progress and density of population, chiefly confined to the thickly wooded and uncultivated tracts of the western states, being particularly abundant in the unsettled parts of Ohio, Kentucky, Illinois, Indiana, and throughout the vast forests of the great valleys of the Mississippi and Missouri. On the banks of the latter river, however, where the woods disappear beyond the confluence of the Platte, the turkey no longer appears, and the feathers of the wings, for the purpose of pluming arrows, form an article of small commerce between the other natives and their western countrymen. For a thousand miles up the Arkansas and Red River, in the wooded alluvial lands, they are not uncommon. They are likewise met with in small numbers in Tennessee, Alabama, and West Florida. From the Atlantic states generally they are now nearly extirpated. The wild turkey is neither gregarious nor migratory, but from the necessity of wandering after food; it is otherwise resident throughout the whole of the vast region it inhabits, including the greatest diversity of climate; and it is prolific in proportion to its natural resources, so that while in the United States and Canada it only breeds once in the year, in Jamaica and the other West India islands it is said to raise two or three broods in the same period. In quest of mast, they therefore spread themselves through the country, and insensibly assemble in considerable numbers to the district where their food abounds. These movements are observed to take place in October (the turkey moon of the aborigines). The males, or *gobblers* as they are often called, from their note, are now seen apart from the other sex, in companies varying from ten to a hundred. The females move singly, or accompanied by their almost independent brood, who all at first shun assiduously the persecuting society of the selfish male. Yet after a while, when their food proves abundant, separate mixed flocks of all ages and sexes often promiscuously join in the bounteous repast. Their migration, very unlike that of the rapid pigeons, is made almost entirely on foot, until their progress is perhaps arrested by a river. Their speed, however, is very considerable, and when surprised, they more commonly trust to their legs than their wings, running nearly with the velocity of a hound. On meeting with an impediment of this kind, after considerable delay, they ascend to the tops of the tall trees, and, at the cluck of the leader, they launch into the air for the opposite shore. The transit is a matter of little difficulty, though considerable labour, for the older birds; but the younger and less robust sometimes fall short of the bank, and are either drowned or attain the land by swimming. After crossing, it is remarked that they often become an easy prey to the hunter, as they seem bewildered by the new country in which they have arrived, or more probably are fatigued by the novelty and extent of their excursion. After long journeys and privations, particularly in frosty weather, or while the ground is covered with snow, they are sometimes reduced to the necessity of making their appearance near farm-houses, where they now and then even associate with the poultry, and enter the stables and cribs after grain. In this desultory and foraging manner they spend the autumn and winter.

"According to the latitude, and the advancement of the season, though always very early in the spring, they begin to be actuated by the instinct of propagation. The males commence their gobbling, and court the society of their retiring mates. The sexes roost apart, but in the same vicinity, and at the yelp of the female the gobbling becomes reiterated and extravagant. If heard from the ground, a general rush ensues to the spot, and whether the hen appears or not, the males, thus accidentally brought together, spread out their train, quiver and depress their rigid wings, and strutting and puffing with a pompous gait, often make battle, and directing their blows at the head, occasionally destroy each other in a fit of jealousy. As with our domestic fowls, several hens usually follow a favourite cock, roosting in his immediate neighbourhood, until they begin to lay, when they withdraw from his resort to save their eggs, which he would destroy if discovered.

"The females are therefore seen in his company only for a few hours in the day. Soon after this period, however, the male loses his ardour, and the advances of affection now become reversed, the hen seeking out the society of her reluctant mate. In moonlight nights the gobbling of the male is heard, at intervals of a few minutes, for hours together, and affords often a gratifying means of their discovery to the wakeful hunter. After this period the males become lean and emaciated, so as to be even unable to fly, and seek to hide themselves from their mates in the closest thickets, where they are seldom seen. They now also probably undergo their moult, and are so dry, lean, and lousy, until the ripening of the mast and berries, as to be almost wholly indigestible, and destitute of nutriment as food. So constant is this impoverished state, that the Indians have a proverb, 'As lean as a turkey in summer.'

"About the middle of April, in Kentucky, the hens begin to provide for the reception of their eggs, and secure their prospects of incubation. The nest, merely a slight hollow scratched in the ground, and lined with withered leaves, is made by the side of a fallen log, or beneath the shelter of a thicket, in a dry place. The eggs, from ten to fifteen, are whitish, covered with red dots. While laying, the female, like the domestic bird, always approaches the nest with great caution, varying the course at almost every visit, and often concealing her eggs entirely by covering them with leaves. Trusting to the similarity of her homely garb with the withered foliage around her, the hen, as with several other birds, on being carefully approached, sits close without moving. She seldom indeed abandons her nest, and her attachment increases with the growing life of her charge. The domestic bird has been known not unfrequently to sit stedfastly on her eggs until she died of hunger. As soon as the young have emerged from the shell, and begun to run about, the parent, by her cluck, calls them around her, and watches with redoubled suspicion the approach of their enemies, which she can perceive at an almost inconceivable distance. To avoid moisture, which might prove fatal to them, they now keep on the higher sheltered knolls; and in about a fortnight, instead of roosting on the ground, they begin to fly at night to some wide and low branch, where they still continue to nestle under the extended wings of their protecting parent. At length they resort during the day to more open tracts, or prairies, in quest of berries of various kinds, as well as grasshoppers and other insects. The old birds are very partial to pecan-nuts, winter grapes, and other kinds of fruits. They also eat buds, herbs, grain, and large insects; but their most general and important fare is acorns, after which they make extensive migrations. By the month of August the young are nearly independent of their parent, and become enabled to attain a safe roost in the higher branches of the trees. The young cocks now show the tuft of hair upon the breast, and begin to strut and gobble, and the young hens already pur and leap. One of the most crafty enemies which the wild turkey has to encounter is the lynx or wild cat, who frequently seizes his prey by advancing round, and waiting its approach in ambush. Like most other gallinaceous birds, they are fond of wallowing on the ground, and dusting themselves.

"When approached by moonlight, they are readily shot from their roosting-tree, one after another, without any

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apprehension of their danger, though they would dodge or fly instantly at the sight of the owl. The gobblers, during the season of their amorous excitement, have been known even to strut over their dead companions while on the ground, instead of seeking their own safety by flight. In the spring, the male turkeys are called by a whistle made of the second joint bone of the wing of the bird, which produces a sound somewhat similar to the voice of the female; and on coming up to this call they are consequently shot. They are likewise commonly caught in quadrangular pens made of logs crossing each other, from which is cut a slanting covered passage sufficient to allow the entrance of the turkey. Corn is then scattered in a train to this cage for some distance, as well as within; and the neighbouring birds, in the surrounding woods, having discovered the grain, call on each other by a clucking, and entering one at a time, they become secured in the pen, as, for the purpose of escape, they constantly direct their view upwards, instead of stooping to go out by the path by which they had entered. The male wild turkey weighs commonly from fifteen to eighteen pounds, is not unfrequently as much as twenty-five, and sometimes, according to Audubon, even thirty-six. The hen commonly weighs about nine pounds; and the usual price for a turkey from the Indians is twenty-five cents."[1]

The only other species of turkey is a very rare and beautiful bird (*M. ocellata*, Cuv.), of which, we believe, only a single specimen is yet known. It was captured by the crew of a vessel who were cutting wood in the Bay of Honduras, and was brought alive to the Thames, for presentation to Sir Henry Halford, but met with an accident which caused its death. It afterwards became the property of Mr Bullock; and on the dispersion of his collection, was purchased by the French government for the Paris Museum. It is nearly equal in size to the common turkey. The tail is less ample, but its colours are more varied and beautiful, almost rivalling those of the peacock in its little mirrors of sapphire, surrounded by circles of gold and ruby.[2]

The species known to us by the name of Guinea fowls, form the genus NUMIDA, Linn. The head is bare, the top in some crested, and the throat wattled. They are all either from Africa or Madagascar.

The great genus PHASIANUS, Linn., including our cocks and pheasants, has the cheeks more or less bare of feathers, usually covered by a scarlet skin, and the tail-feathers so placed as to slope downwards, roof-like, from either side. The group was soon found to be too extensive and varied in its component parts to accord with the preciser views of modern times, and several subdivisions have been in consequence effected.

The restricted genus GALLUS, for example (Plate CCCXCVIII. figs. 3 and 3 *a*), of which the head is generally surmounted by a fleshy vertical crest, the base of the lower mandible furnished with two flattened wattles, and the tail-feathers, fourteen in number, rising in two almost upright planes, with ample coverts in the male sex, contains, among other remarkable species, our domestic *cock and hen* (*Gallus domesticus—Phasianus gallus*, Linn.). The general attributes or special qualities of this brave, vigilant, and invaluable species, need not be here recorded; and indeed a volume would scarcely suffice to describe its numerous variations, from the pure undaunted blood of Derby, fearless of death, to the crested dung-hill breed, almost equally pugnacious, and by no means cowardly, yet apt to turn tail on the sudden touch of unexpected steel.

In our present paragraph we avail ourselves in part of a recent brief compendium. The cocks with ample crests, and five toes,—the rumpless cock, and those of many-mingled colours,—appear to have arisen chiefly from the various and prolonged circumstances attending domestication, and the intentional crossing of the breeds. The most picturesque are those with superabundant crests, and full auricular plumes. The crest is composed of narrow, hackled feathers, which grow erect from the head, but fall down in graceful curves, sometimes of such length as to shadow or overhang the eyes. In some districts this breed is much cultivated, being esteemed in proportion as the colours of the body and crest can be made to form the most conspicuous contrast, the body black, the crest white, and *vice versa*. Other admired fancy breeds are the Dutch pencilled fowl, which are pure white, with black spots; the Siberian fowl, with long tufts of hanging feathers springing from the lower jaw; and the Barbary fowl, of a pale dun colour, with the feathers of the neck extremely ample, and spotted with black. But a more singular anomaly is exhibited by those with five toes, commonly called *dorkings*, from being bred in most abundance in the neighbourhood of Dorking, Surrey. This race is easily continued, and is much esteemed for the table, being white and large. Dr Latham records one which weighed nearly fourteen pounds. A still more remarkable race is that without a tail, the rumpless or Persian cock, as it is sometimes called, which actually wants a portion of the caudal vertebræ. These are usually regarded as mere varieties, for the most part, probably, of accidental origin. There are, however, three races of cocks, of a very marked character, although their claim to actual specific distinction cannot be yet made out. The first is *Gallus morio*, of which the periosteum of the bones is black, and the comb, wattles, and skin, of a dull purple. It has received the name of negro or blackamoor cock, but is scarcely ever seen in the poultry-yards of this country. The other two races are more frequent, and are known as the silky cock (*G. lanatus*), and the Friesland cock (*G. crispus*). M. Temminck is inclined to regard the former as a distinct species. It occurs in China and Japan, where it is sold as a rarity to Europeans. In this country it crosses easily with the white domestic breed, and a mixed race is produced with the feathers still silky, but less disunited. It is singular that the skin and periosteum of this kind are of the same sable hue with those of *G. morio*, although the flesh is remarkable for its whiteness. The size is rather small, the plumage of the purest white, the comb and wattles purple. The Friesland cock evidently belongs to the opposition, having all the feathers turned the wrong way, or standing nearly at right angles with the body. The general colour of the plumage of this kind is also white, but it varies like that of other captive races. It occurs in the domesticated state in Java and Sumatra; but M. Temminck thinks it is also a distinct species, peculiar in the wild state to some unexplored quarter of the Indian islands.[3] We doubt that nature, in her first intent, should ever have produced such an oddity.

Many fanciful and superstitious feelings are still maintained regarding the domestic cock, and his nocturnal crowing; and even his more familiar morning salutation is supposed to dispel all spirits, " whether in sea or fire, in earth or air."

> Some say that ever 'gainst that season comes
> Wherein our Saviour's birth is celebrate,
> The bird of dawning singeth all night long;
> And then, they say, no spirit walks abroad;
> The nights are wholesome; then no planets strike;
> No fairy takes, nor witch hath power to charm;
> So hallowed and so gracious is the time.

[1] *Manual*, vol. i. p. 640.

[2] *Mém. du Museum*, vi. pl. 1; and *Pl. Col.* 112.

[3] *Naturalist's Library*, vol. iii. p. 173.

Of the numerous benefits which the goodness of God has enabled man to derive from the wide circle of the feathered race, there is probably none which surpasses, either in extent or utility, the domestication of these most familiar birds. Of so long standing, however, has been the subservience of the race to man, that no authentic traditionary traces now remain of its original introduction to any of the more ancient kingdoms of the earth,—its existence under human guardianship seeming indeed coeval with the most antique records. It may therefore be regarded as one of those particular and providential gifts, which, like the faithful and accommodating dog, was at an early period of the world added to the fortunes of the first families of the human race, and has since followed man in his wonderful and far-spread migrations through every clime and country. For some thousand years the observers of nature were ignorant of any wild species which, even in a remote degree, resembled any variety of the domestic breed,—and from the era of Herodotus to that of Sonnerat, the domestic cock and hen might have been regarded as birds, the living analogues of which were no longer known to exist in a natural and unsubdued condition.

In consequence of the remote obscurity in which the subject is thus involved, few points in natural history have occasioned more inconclusive speculation, or are even now more difficult to solve with certainty, than the source from which we have primarily derived our different races of domestic poultry. That they came originally from Persia, has been inferred from the circumstance of Aristophanes calling the cock "the Persian bird." Such an origin, however, is improbable, when we consider that the researches of modern travellers, and indeed of all who have visited that country since the revival of learning, have failed to discover there any species of wild poultry,—no gallinaceous bird being found in Persia more nearly allied to the genus Gallus, than a species of *Lophophorus.* If, however, it is merely meant that the Greeks, during the intercourse, hostile or otherwise, which existed between them and the Persian nation, may have obtained a breed previously domesticated, the idea is less objectionable; for it is known that in a domestic state poultry have existed in Persia from a very remote antiquity.

It appears from an ingenious dissertation by the late Dr Scot of Corstorphine, to have been the opinion of that learned Hebraist, that poultry were unknown to the Jews, or at least that they are not distinctly alluded to in the Old Testament. It cannot, however, admit of a doubt, that they were well known over many parts both of Europe and Asia for several hundred years before the Christian era. When Themistocles took the field to combat the Persians, he alluded, while haranguing his troops, to the invincible courage of the feathered biped. "Observe with what intrepid valour he fights, inspired by no other motive than the love of victory; whereas you have to contend for your religion and your liberty, for your wives and children, for the tombs of your ancestors;" and it was on this occasion that the Athenians achieved one of the most memorable victories recorded in history. According to Ælian, it was in commemoration of this signal event, and of the *ornithological* image by which the courage of the soldiery had been excited and sustained, that the Athenians instituted those annual games of which cock-fighting formed so conspicuous a feature. Now Themistocles died in the sixty-fifth year of his age, and about the 449th year preceding the Christian era, and must consequently have been contemporary with Nehemiah the prophet; and as the Old Testament history does not conclude till about twenty years after the death of Themistocles, it may be inferred, that if the later of the sacred historians do not mention poultry, it must be from some other cause than ignorance of their existence,—seeing that as the early Greek nations had received them prior to that period, either from Persia or the more south-eastern countries of Asia, they could scarcely have remained unknown in the *intermediate* regions inhabited by the Jews. For these and other reasons, which it would here be tedious to detail, we do not agree with Dr Scot.

In regard to the natural origin of these domestic birds, the first approximation to the truth (and we deem it but an approximation) resulted from the discovery by Sonnerat of a species of wild poultry native to the mountains of the Ghauts, in India. This is the *Gallus Sonneratii* of systematic naturalists, better known to British residents by the now familiar name of *jungle-cock.* Our knowledge of gallinaceous birds, however, has so greatly increased during recent years, and so many additional species have been discovered, that we are able to proceed upon much more certain ground than were the naturalists of the last century. The jungle-cock is not only no longer the only claimant to the long dormant title which, under whatever name of honour, may be due to the species so greatly beneficial to the human race, but other aspirants have come forward with such better-founded claims, that his may fairly be regarded as altogether set aside. In fact, several important characters of the jungle-cock have never been traced in any of the domestic varieties, and many of these latter present features which, if not incompatible with, at least bear no resemblance to any attributes of the supposed original. We may here observe, that the natural *form* and *structure* of any portion of the animal organization are much less easily effaced or altered than the more superficial character of *colour;* and hence, if a particular species of bird be naturally distinguished by a peculiar consistence as well as colour of plumage, the influence of those causes which produce variation less frequently affect the former than the latter. Reasoning therefore *a priori*, it would be more natural to expect that if the jungle-cock were the parent of our domestic breeds, such breeds, however they might vary in the colouring of their plumage, would at least at times exhibit those marked and peculiar characters of form and structure by which the feathers of the supposed original are distinguished. This, however, is not the case. Amid the infinite varieties which occur among our domestic poultry, the plumage of none is found characterized by those horny laminæ, or expansions of the shaft, which form so marked a feature in the plumage of the jungle-cock, and which assuredly would have either continued a permanent feature, or been occasionally manifested in one or other of our domestic breeds, had these been derived from the species in question. We may mention another circumstance on which we believe we were ourselves the first to insist.[1] The native tribes of Indians inhabiting the districts where the jungle-cock abounds rear a breed of poultry which differs as much from the supposed original as our own, and which never intermingles with the forest brood.

According to M. Temminck (and in this we quite agree with that industrious and observant naturalist), the species to which our domestic races are most nearly allied, are the *Jago cock* of Sumatra (*Gallus giganteus*), a wild species of great size, and the *Bankiva cock* of Java, another primitive species, which occurs in the forests of the last-named island (see Plate CCCXCVIII. figs. 3 and 3 *a*. There are several circumstances which render the claims of these two birds much stronger than those of the jungle-cock. 1*st*, Their females bear a strong resemblance to our domestic hens; 2*dly*, the common village cock, in its most ordi-

[1] See our Essay "On the Origin of Domestic Poultry," in the *Wernerian Memoirs*, vol. vi. p. 402.

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nary condition, is intermediate, in respect to size, between these two species; 3*dly*, the nature of the plumage, which in its form, consistence, and distribution, is absolutely the same as in the common cock, greatly strengthens the supposition; 4*thly*, it is in these species alone that we find the females, as well as males, provided with a fleshy crest and small wattles,—characters which likewise distinguish both sexes of our common poultry, although they are for the most part but slightly developed in the females. Now the female jungle-cock possesses neither comb nor wattles.

It may be stated as a curious though well-known fact, that when Captain Cook first visited the South Sea Islands, he found them well stocked with domestic poultry; and the more recent as well as more ample narratives of the missionaries have confirmed the statements of the great navigator regarding the practice of cock-fighting in Otaheite, and other islands of Polynesia. Mr Ellis describes the *Faa-ti-to-raa-moa*, or literally the causing fighting among fowls, as the most ancient game of the Tahitians; and he informs us, that according to the tradition of the natives, poultry have existed in the islands as long as people,—that they either came with the first colonists, or were produced by Taaroa contemporaneously with men. Long before the first foreign vessel was seen off their shores, they were in the practice of training and fighting cocks. However, they never trimmed, as we do, their flowing plumes, but were proud to see the beautiful and gorgeous combatants with ample natural wings, full-feathered necks, and lengthened tails. We may observe, that the breed of these islands do not appear to have been what in this country we would denominate *game;* for Mr Ellis (in his *Polynesian Researches*) incidentally mentions, that as soon as one bird *avoided* another, he was considered as *vi*, or beaten, and victory was declared in favour of his opponent. It is indeed a singular circumstance that this barbarous practice should have pervaded so many unconnected nations, both savage and civilized. It has entirely ceased among the inhabitants of the Friendly and Society Islands since the establishment of Christianity, although still pursued by the practical heathen of other and more ancient Christian lands. We ourselves, to our shame be it spoken, once fought a main of cocks with an English clergyman, who has since held a high and conspicuous station in the church. We believe, indeed, that he is now a bishop,—haply forgetful of us and of our famous *Faa-ti-to-raa-moa*.

In the genus Phasianus properly so called, the sides of the head around the eyes are covered for a space by a naked warty skin. The tail is very long and slender, each feather laterally inclined or roof-shaped, and the central pair usually much prolonged. The common pheasant of our coverts (*Ph. colchicus*) is the most familiar example. This bird is now well known in most of the temperate parts of Europe, though originally introduced from the banks of the Phasis (now the Rioni), a river of Chalcis in Asia Minor. Need we describe his glowing bright attire?

> Splendid his form, his eyes of flaming gold
> Two fiery rings of living scarlet hold;
> His arching neck a varying beauty shows,
> Now rich with azure, now with emerald glows.
> His swelling breast with glossy purple shines,
> Chesnut his back, and waved with ebon lines;
> To his broad wings gay hues their radiance lend,
> His mail-clad legs two knightly spurs defend.

The variety called the ring-pheasant (*Ph. torquatus*), characterized by a more or less completed circle of white around the lower portion of the neck, is by some regarded as a distinct species. The gold and silver pheasants of our aviaries (*Ph. pictus* and *nycthemerus*), and several other still more magnificent birds, on the beauty of which we regret we cannot here dilate, pertain to our present genus.

One of the most singularly superb of all the gallinaceous order, we mean the argus pheasant, now forms a separate genus under the name of Argus. Of this rare and remarkable bird (*A. giganteus*, Temm.) China and the adjoining provinces of Tartary have been assigned as the native country by various writers. This, however, requires confirmation, as all the specimens of which the origin is accurately known have been brought from the great eastern islands and peninsula of Malacca. There is a passage in Marco Polo's *Travels*, which may perhaps be construed as relating to the bird in question. In his description of the kingdom of Erginal (a district of Tangout, in the north-west of the empire), he observes, "pheasants are found in it that are twice the size of ours, but something smaller than the peacock. The tail-feathers are eight or ten palms in length." "This," observes Mr Marsden, the learned editor of the English edition, "is probably the Argus pheasant, which although a native of Sumatra (where I have frequently seen it alive), is said to be also found in the northern part of China."[1] Though of late years well known in the *Basses-cours* of Batavia (from which M. Temminck received a splendid series), we are not aware that the Argus has been ever imported alive into Europe It would certainly prove a more magnificent addition than any which has been made to our aviaries in modern times. The great apparent size of this bird arises chiefly from the peculiar formation of the wings, of which the secondaries are three times the length of the primaries, being nearly three feet long. In consequence of the unwieldy extent of that portion of the wing which is not under the immediate influence of muscular action, this magnificent bird is alleged to be almost destitute of the power of flight. Its progress, however, when running on the ground, is greatly accelerated,—the expanded secondaries, according to M. Temminck, acting as powerful and capacious sails, and furnishing a very fleet and effectual mode of transportation. The body, when stripped of the feathers, scarcely exceeds that of a barn-door fowl, but in its "high and *plumy* state" it measures in total length about five feet three inches,—the tail-feathers being themselves nearly four feet long. The female is, as usual, less adorned. Her secondaries want the peculiar breadth and extension, as well as the beautiful eye-like markings which adorn the male. In consequence, however, of this homely appearance, she is less frequently sought for in her native forests, and is thus (in collections) by far the rarer of the two. M. Temminck, for example, thought himself fortunate in finding a brace of females among thirty males.

In the genus Euplocomus, Temm., the head is crested, the tail much broader than in the true pheasants, and sometimes forked. The beautiful Macartney cock, or fire-backed pheasant (*Eu. ignitus*), is the most characteristic, if not the sole example. It was met with by Sir George Staunton in a menagerie at Batavia, and is believed to be a native of Sumatra.[2]

The horned pheasant of Edwards and Latham has been made by Cuvier to constitute the genus Tragopan. The head, though crested, is elsewhere almost naked; a little slender horn projects backward from behind each eye, and a loose and pendent skin, inflatable at pleasure, hangs from the base of the lower mandible (see Plate CCCXCVIII. fig. 4). The group now consists of about four species, all remarkable for their richly varied and beautifully spotted plumage. They are bulkier birds than pheasants, with rounded tails of ordinary length. The females of such as are known are brindled with brown and black. We have yet learned nothing of the habits or natural economy of the Tragopans, although their external aspect has been rendered familiar in elegant representations by Mr Gould.[3] The

[1] *Travels*, pp. 225–9.
[2] *Embassy to China*, pl. xiii.
[3] *Century of Birds from the Himalaya Mountains.*

first discovered species (*T. satyrus*), though usually brought from Nepaul, has been ascertained also to inhabit Thibet; and Chinese specimens from the mountain province of Yunnan were seen by Mr Bennet in Mr Beale's aviary at Macao.[1]

The genus CRYPTONYX, Temm., has a bare space around the eye, the tail of medium size and flat, and the tarsi without spurs; but the most peculiar character consists in the hind toe being destitute of claw. The best-known species is *C. coronatus*, or *rouloul* of Malacca (see Plate CCCXCVIII. fig. 5). The female is described by Latham under the title of *Tetrao viridis*. It inhabits deep forests, is wild and cunning in a state of nature, and in confinement impatient of restraint.

The great genus TETRAO of Linn. has also been greatly subdivided in recent times. All the species seem to agree in having a bare band above the eye.

The restricted genus TETRAO has the legs covered with feathers, and without spurs. In some the toes are naked, and the tail either forked or rounded. Such is the great wood grouse or capercailzie (*T. urogallus*), the largest and finest example of the gallinaceous order indigenous to Europe. In Britain it has been long extinct in the wild state (although of late several times imported with a view to re-establish the breed), and now occurs chiefly in Scandinavia, although not unknown among mountainous and woody regions southwards, as far as the Alps of Savoy and the Veronese. Although rather difficult to rear in Britain, the capercailzie is often domesticated in Sweden, where it becomes so tame as to eat familiarly from the hand. Though naturally shy and wary, they sometimes, even in their unreclaimed condition, manifest a singular and unaccountable degree of boldness. Mr Brehm mentions a cock bird that inhabited a wood near Renthendorf, through which there was a roadway, and whenever any one passed through, it would fly towards him, peck at his legs, and strike him with its wings. The black-cock (*T. tetrix*) is a smaller, but very beautiful species, of hardy habits, and much on the increase in many parts of Britain, where it prefers alpine pastures, with a sprinkling of natural wood, intermingled with moist places covered by long coarse herbage. It is widely dispersed over the northern and temperate parts of Europe, and spreads somewhat farther south than the preceding, being found, though rarely, on the Apennines. We know that it breeds among the lofty hills above Albenga, near the Colle de Tende. Other species of bare-toed grouse occur in Europe, and a still greater number in North America. For the history of the latter we must refer to the well-known works of Alexander Wilson, C. L. Bonaparte, Audubon, Richardson, and others.

Of the feather-footed game-birds (genus LAGOPUS), the most noted for gastronomic excellence is our common red grouse, or moor-game (*L. Scoticus*), so highly prized and eagerly pursued by sportsmen. This well-known species restricts itself chiefly to the sides of sloping mountains, and those extensive tracts of elevated land called moors, where it is careless of other shelter than that afforded by the natural roughness of the ground, and its plentiful covering of heath, or other alpine plants of still more lowly growth. The most singular fact in its history is its restriction to Great Britain and Ireland,—all other parts of the world, from "Indus to the pole," being sought in vain for a single example. In this little group we also place the ptarmigans, distinguished from the other grouse by the assumption of a snow-white plumage during winter. These birds seem to prefer, in comparatively temperate climates, such as that of Scotland, the bare and stony sides or summits of the highest mountains; but under the rigorous temperature of Greenland, and the most northern portions of America, they are chiefly found in the vicinity of the sea-shore, by the banks of rivers, and among the willow and other copse woods of the lower and more sheltered vales. The species of Europe and America are not yet in all respects sufficiently characterized and distinguished.

The genus PTEROCLES, Temm., has a naked space around the eye, but not of a scarlet colour, as in grouse; the toes are bare, the hind one very small, and the tail pointed (Plate CCCXCVIII. fig. 6). These birds, called gangas, or sand-grouse, live in sandy plains and deserts in the warmer regions of Asia and Africa, although two species, *Pt. arenarius* and *setarius*, Temm., inhabit some of the southern countries of Europe, especially Spain. The latter is the pin-tailed grouse of Latham, *Tetrao alchata*, Gmelin.

The genus PERDIX of Brisson contains the partridges, distinguished by having the legs or tarsi bare, as well as the toes. The tail is also very short, although of greater length among the kind called francolins, and other foreign species. Of these several are armed with spurs; and one especially, the sanguine partridge (*P. cruentata*, Temm.), has sometimes three or four spurs on each leg. The francolins perch on trees. The partridges properly so called always rest upon the ground. Their bill is not so strong, and their spurs, if they have any, are very short, or simply tubercular. Four or five sorts are found in Europe, although the common gray partridge (*P. cinerea*) is our only truly indigenous kind. The red-legged partridge (*P. rubra*), which in Italy is the most frequent, has been introduced of late years into the south of England, where it continues to breed spontaneously in a state of nature. Many other species occur in foreign countries.

The quails (genus COTURNIX) are of smaller size than the preceding, the tail is still shorter, the spurs are wanting, and there is no coloured space above the eye. The only British species is the common quail (*C. Europeus*), a well-known bird of passage, generally but not abundantly distributed over the island. In Scotland it is even scarce, although we have found it occasionally near Edinburgh, as well as in Ross-shire, and along the coasts of Aberdeen and Kincardine. The whole migrate from the colder and temperate parts of Europe during autumn, and re-appear in spring, in certain places, in enormous numbers. Along the Neapolitan coasts, for example, 100,000 have been taken in a single day. In some of the southern countries of Europe, however, many quails remain throughout the winter. In Portugal they are even more numerous during that season than in summer; and Signor Savi says, in regard to those of Italy, "Sono le quaglie uccelli viaggiatori, giacchè la massima parte lasciano l'Europa, traversano il mare, e vanno a passare il verno in Affrica, ed in Asia; ma di Toscana, come pure dalle altri parti meridionali, non partono tutti, anzi una gran quantità ne resta per le stoppie delle nostre Maremme, ove trovano e molto nutrimento e dolce clima. Negli ultimi giorni d'Aprile si rimetteno in moto; quelle che avevan passate il mare lo passan di nuovo, e quelle che eransi ritirate ne' siti aprici si spargon per tutti i campi e prati."[2] A vast number of quails of various kinds are found in foreign countries. A beautiful small species (*C. excalfactoria*, Temm.,—*P. Chinensis*, Lath.) is very abundant in China, where it is bred in the domestic state, and kept in cages for the singular purpose of warming people's hands in winter. It is also patronised on account of its pugnacious disposition, being fought with its own kind, as common cocks are in this country.

The American quails now form the genus ORTYX, and are in some measure intermediate between the true quails and partridges. The bill is thick and strong, but short

[1] *Wanderings*, &c. vol. ii. p. 61.

[2] *Ornitologia Toscana*, tom. ii. p. 200.

Rasores.

and rounded; the tail more lengthened than in those of the old continent. One species, *O. Californica*, has the head ornamented by a beautiful slender recurved crest. (See Plate CCCXCVIII. fig. 7.) Several other kinds were recently discovered and described by the lamented Douglas, the botanical traveller and collector, whose tragical fate in the Sandwich Islands recently excited the sympathy of the scientific world. They differ from the ordinary quails in usually perching upon trees at night. The Virginian Ortyx, *O. borealis*, has of late years been reared in several parts of England, and is now almost naturalised in Sussex. It is considerably larger than the common quail.

The genus ORTYGIS of Illiger resembles the quails in general form, but the bill is somewhat compressed. The toes are so deeply divided, as scarcely to exhibit a vestige of the usual intervening membrane, and the hind toe is wanting. The species are of small size, and occur in India, Africa, and New Holland. They are of polygamous habits, and dwell in barren places on the confines of deserts, seldom taking wing except when closely run. One of these birds is also much used by the Malays and other eastern nations for fighting with its kind. (See Plate CCCXCVIII. fig. 9.)

A bird of a very anomalous aspect and character, called the heteroclyte grouse (*Tetrao paradoxus* of Pallas), now forms the genus SYRRHAPTES of Illiger. The bill is rather slender and compressed, straight, but as usual somewhat bent towards the tip. The tarsi are short and densely clothed with feathers; the toes are also very short and feathered, and connected together almost to the claws. The hind toe is not wanting, but seems buried in the feathers. The wings and tail are very long, and are both terminated by lengthened slender-pointed plumes. The only known species (named *S. Pallasii* by M. Temminck), inhabits the deserts of Tartary, near the shores of Lake Baikal. Owing to the peculiar structure of its feet, it can scarcely move upon the ground; but its flight is brisk and rapid, though seldom long sustained.

The last group we shall here mention contains the *Tinamous*—genus TINAMUS, Lath.,—*Crypturus*, Illig. (Plate CCCXCVIII. fig. 8.) The bill is lengthened and slender, slightly arched, blunt-pointed, grooved on each side, the nostrils central, deepening obliquely backwards. The wings are short, the tail almost rudimentary. The palmation at the base of the toes is very short; and the hind toe, reduced almost to a little spur, does not reach the ground. The bare space around the eye is very circumscribed. These birds abound in the Brazilian and other tropical forests of America, where they run swiftly, seldom fly, conceal themselves among long herbage, and perch (as some say) upon the lower branches of trees. They live on fruits and insects, and their flesh is much esteemed. Rather than exercise their natural powers of flight, they will sometimes foolishly allow themselves to be killed in great numbers with a stick. They are also hunted with dogs. They build upon the ground, and their eggs are remarkable among those of gallinaceous birds for their brilliant tinting, some being bright blue, others of a brilliant violet colour. The different species of Tinamous exhibit a great diversity in size, from that of a pheasant to a very small quail; and "as for their flesh," says Mr Swainson, "we have often tasted it, and consider it, both in whiteness and flavour, infinitely above that of the partridge or pheasant. We believe these birds never perch, as some suppose, but that they live entirely among herbage, principally in the more open tracts of the interior."[1]

The great family of the pigeons (COLUMBA, Linn.) comes next in order in Baron Cuvier's arrangement, and in that indeed of most of our systematic writers. There are several circumstances, however, which make it doubtful whether the pigeons should not form either a separate order of themselves, or undergo some other change in their position. As compared with ordinary gallinaceous birds, every one will admit that they present numerous and striking disparities. Their powers of flight, for example, if equalled are not surpassed even by those of the falcon tribe, their habits are monogamous, their haunts very generally arboreal, their eggs few in number, and hatched by the male as well as female, the young are at first extremely helpless, and are fed for a length of time from the crop of both parents,—in all these points, and many more, they differ remarkably from other gallinaceous birds. Professor Savi, we observe, places the pigeons in his concluding tribe of Passeres (*Uccelli silvani*), as a connecting link with the gallinaceous order, and for reasons closely corresponding with those we have just assigned.[2] Mr Macgillivray has recently observed, that "the beautiful, very extensive, and generally distributed family of birds commonly known by the names of pigeons, doves, and turtle-doves, appears to form an order of itself, separated by well-defined limits; but yet, as in other cases, presenting modifications of form indicative of its affinity to conterminous groups. The peculiar shape of the head and bill, more than any other external feature, serves to render the different species readily cognizable as belonging to a single tribe; for, whatever may be the size, colour, or even shape, of a pigeon, it cannot be mistaken. But the relations of the family, it would appear, are not so readily perceived,—some of our most approved systematists having associated them with the passerine, others with the gallinaceous birds,—while a few consider them as constituting a distinct group. Linnæus included them all under the single genus Columba, which has merely been sectioned by M. Temminck, and from which M. Vieillot has only separated two genera under the names of Treron and Lophyrus; while Mr Swainson and other Ornithologists have converted it into several generic groups, such as Vinago, including the thick-billed species, Ptilonopus, Columba, Turtur, Ectopistes, Peristera, and others, characterized by differences in the wings and tail; and Lophyrus, formed, by Vieillot, of the great crowned-pigeon. The latter seems to connect this family with the Cracinæ, which belong to the gallinaceous order, while other groups manifest an affinity to the partridges and allied genera. The pigeons vary much in form, some having the body full, others slender; while the tail is very short, moderate, or greatly elongated. In all, however, the head is small, oblong, compressed, with the forehead rounded; a circumstance depending partly upon the form of the skull, and partly upon the absence of feathers at the base of the bill. The latter organ is characterized more especially by having the nasal membrane bare, generally scurfy, fleshy, and tumid, with the narrow longitudinal nostrils placed under its anterior margin. It varies in size, but the upper mandible has its ridge always obliterated at the base by the encroachment of the nasal membranes, and its extre-

[1] *Nat. Hist. and Class. of Birds*, vol. ii. p. 168.

[2] "Questa tribù forma il passagio dai Silvani ai Gallinacei, giacchè i Piccioni, quantunque somigliano più ai primi che ai secundi, pure han caratteri comuni agli uni ed agli altri. Somigliano i Silvani, perchè avendo ali grandi e coda larga, volano facilmente, con velocità, ed a grandi distanze; sono monogami: nascono nudi, e per un tempo assai lungo (almeno per tutte le specie nostrali) non essendo capaci nè di moversi, nè di cercare il cibo, han bisogno d'esser covati, e imbeccati da' lcro genitori: fanno il nido sugli alberi, o nelle buche. Somigliano poi i Gallinacei per avere un gozzo molto dilatabile, e dove gli alimenti si trattengono e provano una certa preparazione alla digestione: i semi, di cui quasi esclusivamente si cibano, li inghiottono senza sbucciarli, o romperli, e finalmente, come i Gallinacei, hanno lo sterno doppiamente scavato." (*Ornitologia Toscana*, tom. ii. p. 152.)

mity horny, arched, or convex, more or less compressed, with a blunt thin-edged point. The tongue is fleshy, tapering to a point, and triangular in its transverse section. The throat is very narrow. The œsophagus is of moderate width, but expanded, or opening into a large crop, placed on the lower part of the neck and the fore part of the breast, and terminates below in an oblong proventriculus, completely surrounded with large oblong glandules. The stomach is a powerful gizzard of a somewhat rhomboidal form, and furnished with two very thick lateral muscles inserted into two tendinous centres, with an inferior thinner muscle inserted into the same tendons. The intestine is long and slender; the cæca very small and cylindrical; the rectum very short, and but slightly enlarged. The tarsi are generally short and stout, either scutellate or feathered. The foot is of that kind equally adapted for walking and perching, having three toes before and one behind; the middle toe considerably longer than the two lateral, which are nearly equal, and the hind toe directed backwards, and shorter than the lateral. They are covered above with numerous short scutella, laterally margined, beneath flat and papillate. The claws are short, compressed, moderately arched, rather blunt. The plumage is various, so that no general character can be derived from it, farther than that the feathers have the tube very short, the shaft commonly thick, and are entirely destitute of the accessory plumule, which is largely developed in the gallinaceous birds. The wings are for the most part large, more or less pointed, with the second, third, and fourth quills longest; but the primary quills vary in form, and present several very curious modifications. The tail is even, rounded, cuneate, or graduated."[1] The skeleton, Mr Macgillivray further remarks, differs very materially from that of gallinaceous birds, and the intestine is much longer, the difference, however, in the other Gallinæ being made up by the great development of the cæca, which in pigeons are merely rudimentary, that is, extremely small, and secreting only a mucous fluid. We may add the following important character, that the hind toe is articulated on the same plane with the three anterior ones, instead of being placed higher up, as in the rest of the gallinaceous order. Although their legs are short, pigeons walk with great ease and considerable celerity.

These beautiful birds abound in most of the temperate and tropical regions of the earth, being, however, both more numerous and more gorgeously attired in the latter, where they often rival even the tribe of parrots in the splendour of their plumage, and literally realize the delightful expressions of the Holy Scripture—"as the wings of a dove covered with silver, and her feathers with yellow gold." The old genus Columba is one of the most cosmopolite with which we are acquainted, being found diffused alike through Europe, Asia, Africa, and America; and even in the forests of the far-distant Southern Ocean, their radiant plumage

> Fills many a dark obscure recess
> With lustre of a saintly show.

In no tribe of the feathered race do we meet with more to delight the eye by its richness and diversity. "In some," says Mr Selby, "the plumage shines with a dazzling and metallic gloss, varying in tint with every motion of the bird, and which vies in lustre with that of the diminutive and sparkling humming-birds. In texture the plumage is generally close and adpressed, and the feathers feel hard and firm to the touch, from the thickness and strength of the rachis or shaft. Upon the neck they assume a variety of forms, in some species being rounded and stiff, and disposed in a scale-like fashion; in others of an open, disunited texture, or with the tips divided and curiously notched; and in the hackled and Nicobar pigeons they are long, acuminate, and laciniated, like those of the domestic cock; and, we may add, that in nearly all they are so constituted as to reflect prismatic colours when held at various angles to the light."[2]

The vast variety of species and numerous sub-genera of which the *Columbidæ* are now composed render a full exposition impossible. We must, indeed, rest satisfied with a very brief notice of a few remarkable kinds. We have four species of pigeon in Britain, and we are not aware that more occur in Europe.

1*st*, The ring-dove, cushat, or wood-pigeon, *C. palumbus*, Linn., a large, beautiful, and well-known species, very generally distributed over the more or less wooded districts of our island, but avoiding bare and rocky regions. It breeds on trees in single isolated pairs, but is often gregarious to a great extent in winter. It is a wary bird, of powerful wing, not easily approached even in the forest glades, yet not seldom building in groves or groups of trees in the immediate vicinity of human dwellings; and we have seen a gentle pair sitting for hours upon the branches of an almost leafless sycamore in early spring, preening their feathers in assured confidence, within a few footsteps of our cottage door. Indeed we have often noticed, as others must have also done, what may be called the *discrimination* of birds, in relation both to persons and to places. We allude to what we should call their accommodating rather than their natural instincts,—how, for example, after a season or two of observation or experience, they will congregate around a spot where no rude hands disturb their mossy dwellings, nor climbing urchin shows his visage grim among the umbrageous boughs. This is beautifully exemplified (and on a greater scale than in a cottage garden) among the gladsome palace-groves of the Tuileries and Luxembourg in Paris, where, notwithstanding the gay and giddy stream of human life which flows for ever through those royal walks, the wood-pigeon builds her frequent nest, though far her flight to rural solitudes for every offering which she brings her much-loved young. This species generally breeds twice a year.

2*dly*, The rock or wild pigeon, *C. livia*, Briss., a smaller species, totally regardless of all the leafy glories of the forest, but loving devotedly the craggy cliffs and hollow caverns by the ocean-shore. This species is believed to be the original of our common domestic breed, of which the numerous and extraordinary, yet, with proper care, permanent varieties, are among the more puzzling problems of Ornithology.[3]

3*d*, The smaller wood-pigeon, erroneously called the stock-dove, *C. œnas*, Linn. This bird is much more limited in its distribution than either of the preceding, being as yet unknown in Scotland, and frequenting chiefly the southern and midland counties of the sister kingdom. It is almost entirely confined to wooded districts, its habits, according to Mr Selby, being strictly arboreal; yet Mr Salmon records it as abounding in heaths and rabbit warrens in the neighbourhood of Thetford, to which it annually resorts for the purpose of nidification.[4]

4*th*, The turtle-dove, *C. turtur*, Linn., a small and delicate species, unknown in "bleak Caledonia," but a constant summer bird in Kent, and other counties of the south of

[1] *British Birds*, vol. i. p. 249.

[2] *Naturalist's Library*, vol. v. p. 88.

[3] For the domestic breeds, see Temminck's *Hist. Nat. Gén. des Pigeons et des Gallinacées*, MM. Boitard and Corbie's *Monographies des Pigeons Domestiques*, the *Pigeon Fancier*, and other works.

[4] *Magazine of Natural History*, vol. ix. p. 520.

Rasores.

England, where it breeds in woods. It is sometimes seen towards the end of summer in little flocks of a score or two together. This bird leaves Britain in the course of the autumn, and does not to our knowledge remain in any part of Europe throughout the winter season.

Of the exotic pigeons one of the most remarkable is the goura, or great-crowned pigeon, *Lophyrus coronatus*, Vieillot (see Plate CCCXCIX. fig. 1). It is by far the largest of the tribe, measuring nearly two feet and a half in length. It inhabits Java, New Guinea, and most of the Molucca Islands, and is occasionally brought alive to Europe, where, however, the climate is too moist and variable to admit of its ever attaining to a good old age.

One of the most magnificent of the tribe is the hackled pigeon (*C. Franciæ*), distinguished by the irregular form of the feathers on the head, neck, and breast, which are long and narrow, and terminate in a shining appendage resembling in consistence, though not in colour, the tips of the wing-feathers of the waxen chatterer. It inhabits Southern Africa and the island of Madagascar. Another singular species is the parabolic pigeon (*C. arquatrix*), discovered by Vaillant, and figured in his splendid work on the birds of Africa. The flight of this bird is very remarkable. It never proceeds in a straight line, but on commencing its route describes a parabola, and continues forming a series of arcs during the whole time, frequently uttering a peculiar cry. It inhabits the forests of Anteniquois, and is so bold as to persecute the white eagle.

The caruncu1ated pigeon (*C. carunculata*, Temm.) is placed by Mr Selby with the ground doves, genus GEOPHILUS of that author. This little group is not only distinguished by a greater length of tarsus and other organic characters, but by a striking departure from the general economy of the Columbidæ, the number of eggs not being confined to two, but extending to eight or ten. Incubation also takes place upon the ground; and the young, like those of the true gallinaceous birds, are produced from the egg in so matured a state as to follow their parents from the first. They live entirely on the ground, but roost at night on trees and bushes. The carunculated species just referred to is observed by M. Temminck to show a strong resemblance to the gallinaceous tribes both in aspect and manners. The fleshy scarlet lobes around the eyes and throat correspond, it is supposed, to the wattles of domestic poultry. It builds its nest in slight depressions on the ground, of twigs and stems of grass, and lays from six to eight eggs, which are sat upon alternately by male and female. The young are able to follow their parents as soon as hatched, and are led about by them, and brooded over with extended wings. Their first food consists chiefly of the larvæ of ants and other insects, and when greater strength is gained, of seeds and berries. The beautiful Nicobar pigeon (*C. Nicobarica*, Lath.) has been likewise referred to the same genus. Though of a heavy form and ungraceful carriage, it yields to none of its tribe in splendour of plumage, of which the prevailing hue is rich metallic green, with various reflections of copper and purplish red. It is generally described as residing habitually upon the ground, where it runs with great celerity,—perching on the lower limbs of trees at night. Yet Mr Bennet alludes to this species as usually seen perched on trees, even on the loftiest branches,—where, he adds, it rears its young "similar to all the pigeon tribe."[1] It inhabits Nicobar, Java, Sumatra, and other eastern islands.

We have already alluded briefly to the turtle-dove. The most common kind in cages, in this country, is not the English species, but that called the laughing or collared turtle, *T. risorius* (*torquatus*, Briss.). It is bred with great facility in Britain, but the winter cold would probably be too much for it out of doors; and it seems, moreover, to want that instinct of local attachment which induces our common pigeon to continue in the place where it was born and bred. In its natural state this species occurs in various parts of Africa.

Somewhat resembling the turtles in the length of its wings and tail is the famous passenger pigeon of America, of whose rapid flight and countless congregations we have such graphic accounts in the delightful pages of Wilson and Audubon. This bird is the *Columba migratoria* of authors, and is placed by Mr Swainson in his genus ECTOPISTES. It may be presumed to be sufficiently common in North America, from a fact, or rather calculation, given by Alexander Wilson. He estimated a flock which continued to pass above him for the greater part of a day, to have been a mile in breadth, and 240 miles in length, and to have contained (three birds being assigned to every square yard), at least *two thousand two hundred and thirty million two hundred and seventy-two thousand pigeons!* Mr Audubon confirms his predecessor's account by a narrative still more extraordinary; and adds, that as every pigeon consumes fully half a pint of food (chiefly mast), the quantity necessary for supplying *his* flock must have amounted to *eight millions seven hundred and twelve thousand* bushels per day![2] We wonder, after this, that any farmer should ever dare to migrate to America.

The genus VINAGO of Cuvier consists of pigeons with strong solid compressed bills, short tarsi, and broad distinctly bordered feet. They inhabit forests, live on fruits and berries, and occur in the tropical regions of the old world. Their prevailing colours are various shades of green and yellow, contrasted with purple or reddish brown. The *Columba aromatica* of Latham is a Vinago. (See Plate CCCXCIX. fig. 3.)

We shall now close our brief sketch of the gallinaceous order.

ORDER V.—GRALLATORES.[3]

SHORE-BIRDS, OR WADERS.

Grallatores.

The characters of this order, so far as they can be formally stated, are as follows. The shape of the bill is indeterminate. The legs are long and slender, and more or less bare above the tarsus. There are three anterior toes, more or less united at their bases by a membrane or rudimentary web. The hind toe is wanting in one division of the order.

Among the extensive and varied tribes which constitute the grallatorial order, the bill, as we have just intimated, is formed after so many different models (though always in beautiful accordance with the habits of each particular group), that its structure cannot be generalised, or sententiously expressed. The structure of the feet and legs is also admirably adapted for the exercise of their peculiar habits of life, being so lengthened as to admit of the species wading to a considerable depth without wetting their feathers, and of running with great rapidity along the margins of lakes and rivers, or the sea's more sandy shores. It is to this length of limb that they owe the name of *Grallatores*, as if they went on stilts. The French title of *echassiers* is also derived from the resemblance which the legs bear to the *echasses*, so frequently used by the natives of the *landes* of Aquitaine. A too exclusive attention, however, to this character seems to have misled some modern naturalists, who have included several very remotely

[1] *Wanderings*, &c. vol. ii. p. 64.

[2] See his interesting account of the passenger-pigeon, in *Ornithological Biography*, vol. i. p. 319–26.

[3] GRALLÆ, Linn.

allied genera under one order. Indeed a considerable diversity of opinion exists as to what ought to form the component parts of the grallatorial order. By means of the flamingoes and others, they are closely allied to the natatorial or web-footed birds,—while a dismemberment, partly from the latter order, partly from the original Grallæ, has been advocated in favour of the Grebes, Phalaropes, &c. as a separate and intermediate division under the name of *Pinnatipedes.*

The Grallatores seek their food in marshes, and along the banks of rivers and the shores of lakes. They also frequent the sea-coasts, where many kinds, especially in autumn, congregate in numerous flocks. But although the habits of the majority are *littoral*, many haunt habitually the arid deserts, the green and sedgy meadows, or the upland moors. Who knows not the plover's wailing cry among the desolate mountains,—the curlew's shrilly voice, " a viewless spirit of the elements," far up amid those scenes of pastoral melancholy, where the lonely rocks seem sometimes silent as gigantic spectres, and anon resound with varied and innumerable bleatings, as some gray-haired shepherd, " loving the land which once he gloried in," his dog his sole companion, gently leads along the fleecy people? In truth we often seek in vain to generalise the habits of the feathered race. In our systems we can give them both a local habitation and a name, but in nature they have wings, and like the wind travel where'er they please, and no philosopher either from field or college can say from whence they come, or whither they are going. The food of our present order varies according to the form of the mandibles. Such species as are provided with a long, hard, sharp-pointed bill, as in the heron tribe, live on fish and reptiles; the species in which that organ is softer and more flexible feed on worms and insects, whilst a more limited number, for example the land-rail (*Rallus crex*). are partly granivorous, and consequently affect a drier soil. The jacana (*P. chavaria*) is said to feed on grass. The habits of many species are migratory; and it has been remarked, that the young and old birds always perform their journeys in separate assemblages. A great proportion of the order congregates in the southern countries of Europe before the arrival of winter,—a season which many of them are supposed to spend in Africa. A few are winter birds of passage, that is to say, the temperate countries of Europe form their southern boundary, and during the breeding season they seek the colder regions of the north. The woodcock breeds in Scandinavia, where the observant traveller may frequently see it, not as with us the harbinger of storms, but darting across his dappled dusty path " in the leafy month of June." However, in several parts of the north of Scotland, woodcocks are now very frequent throughout the summer season, rearing their absurd-looking, long-billed progeny along the banks of the Dee, or in the well-wooded valleys of the eastern parts of Ross-shire. The smaller species, such as rails and sandpipers, run with great celerity; the paces of the larger kinds are more measured and sedate. During flight the legs in many kinds are extended on a line with the body. In some entire genera, and in certain species of other genera, the moult is double, that is, takes place both in spring and autumn, and occasions a great disparity between the plumage of the winter and summer seasons. The attire of the sexes is for the most part not very dissimilar. An apparent non-conformity may be said to exist in a few of the species, between the structure of the feet and the functions of these organs, which would disenable us from indicating, *a priori*, the habits of such species merely from an inspection of their organization. For example, the water-hen (*Fulica chloropus*) is an excellent and constant swimmer, and much more strictly aquatic than the avocet or flamingo, yet its toes are long and deeply divided, and furnished with an extremely narrow rudimentary web, while the last-named species, though semi-palmated, never voluntarily venture beyond their depth.

The migratory movements of the Grallatores are probably determined in a great measure by the necessity of obtaining suitable nourishment. The rigour of a Scandinavian winter, which entirely congeals the surface of the moist forest-lands of Sweden and the swamps of Lapland, drives the woodcock to seek its food in the comparatively milder copses of Britain and Ireland; while the landrail, which is with us a native or summer bird, migrates in autumn to more southern regions, where it is probably known only as a winter visitant. Analogous facts have been observed in various parts of the world. Thus in regard to North America, the Grallatores, feeding by preference in marshy and undrained lands, frequent the Saskatchewan prairies only in the spring; and as soon as the warm and comparatively early summer has rendered the soil too dry for their accustomed purposes, they retire to their breeding places within the arctic circle. " There," says Dr Richardson, " the frozen sub-soil, acted upon by the rays of a sun constantly above the horizon, keeps the surface wet and spongy during the two short summer months, which suffice these birds for rearing their young. This office performed, they depart to the southward, and halt in the autumn on the flat shores of Hudson's Bay, which, owing to the accumulations of ice drifted into the bay from the northward, are kept in a low temperature all the summer, and are not thawed to the same extent with the more interior arctic lands before the beginning of autumn. They quit their haunts on the setting in of the September frosts, and passing along the coasts of the United States, retire within the tropics in the winter."[1]

The majority of the Grallatores are swift and powerful flyers, being provided with rather long, acutely-pointed wings; but to these attributes we have a few strong and singular exceptions in such birds as the ostriches and cassuaries, which have scarcely any wings, and cannot fly at all.

Baron Cuvier has established the five following tribes among the Grallatores, viz. BREVIPENNES, PRESSIROSTRES, CULTRIROSTRES, LONGIROSTRES, MACRODACTYLES.

TRIBE 1ST.—BREVIPENNES.

The small number of gigantic birds which constitute our present tribe differ greatly, not only from the other Grallæ, but from all known species; 1*st*, in the extreme shortness of their wings, which, though no doubt useful in their way, are altogether destitute of power to raise their bodies from the earth; and, 2*dly*, in the sternum or breast-bone being destitute of a ridge or keel. The muscles of the breast are also extremely slight and thin. " Il paraît," says Cuvier, " que les forces musculaires, dont la nature dispose, auraient été insuffisantes pour mouvoir des ailes aussi étendues que la masse de ces oiseaux les aurait exigées pour se soutenir en l'air."[2] This is not expressed according to the English mode of thought and feeling, but it may pass for what it means. To make amends, however, for this supposed incapacity of nature, we find that the muscles of the legs have received an enormous developement, which enables the species to run almost with the rapidity of race-horses, and to be thus independent of aërial flight. In some of our modern systems these birds form the family *Struthionidæ*, and are placed in the gallinaceous order.

In the genus STRUTHIO, which contains the true ostrich,

[1] *Fauna Boreali-Americana*, part ii. Introduc. p. xix.

[2] *Règne Animal*, tom. i. p. 494.

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the wings are adorned by loose flexible plumes, and though of small extent, are still sufficient to afford effectual aid in running. The toes, at least externally, are only two in number.

The only known species is the ostrich commonly so called (*Struthio camelus*, Linn., Plate CCCXCIX. fig. 5), a bird which forms one of the most remarkable characters in the Ornithology of Africa, to which country it is believed to be almost entirely peculiar. It presents the tallest, and in many other respects the most singular example of the feathered race. It measures from six to seven feet in height; its head is very flat, extremely small, and almost naked; as is also the upper portion of the neck, which is very slender, and nearly three feet long. The general plumage of the male is black, varied with white and gray, the fine full feathers of the wings and tail being either black or white. Our engraving will best explain its outer aspect. The female is brown or ashy-gray upon the body; the young are likewise of the latter hue, and have at first the head and neck densely clothed. The ostrich inhabits the deserts of Arabia, and a vast extent of open sandy plains in Africa, from Barbary to the Cape of Good Hope. Being consequently native to one of the most anciently peopled countries of the earth, it has excited the attention of mankind from the remotest periods of antiquity. It is frequently mentioned in the book of Job, and in other portions of the Old Testament. Herodotus among the early Greek writers was well acquainted with its history and appearance, and in after times it was not only frequently exhibited by the Romans in their games, but the brains of hundreds at a time were scooped out as a choice delicacy for the luxurious table of Heliogabalus.

The ostrich is gregarious and polygamous. The female deposits her eggs, weighing nearly three pounds, in the sand. These, in equatorial regions, are hatched by the heat of the sun, with little or no attention on the part of the mother; but on either side of the tropics are said to be incubated in the usual fashion. This gigantic bird feeds naturally on seeds and herbage; but its taste is so obtuse, and its swallowing propensities so universal, that there are few substances, however incongruous or indigestible, which it declines. It is said by some to be the swiftest of all running creatures, and Adanson seemed satisfied that those he saw at Podor, a French factory on the southern side of the Niger, would have distanced the fleetest race-horse that was ever bred in England. There is no doubt that the peculiar construction of birds, in relation both to the respiratory and circulating systems, is such as to admit of their keeping in much better *wind* than is possible for any quadruped; and when, as in the case of the species in question, great muscular power is superadded, the natural result must be prodigious swiftness.

The nandou or American ostrich now forms the genus Rhea, of which it is the sole species, characterized by having three toes, the wings terminated by a little spur, and the tail wanting. It is not above half the size of an ostrich, of a whitish-gray, lead coloured on the back, the head covered with close-set blackish feathers, almost as stiff as hair. This bird inhabits the pampas of Paraguay, in troops of a few dozen, and extends almost as far south as the Straits of Magellan. It is a gentle, innocent creature, of herbivorous habits, easily tamed if taken young, and laying an enormous number of eggs. As several females sometimes sit together, it is probable that the number of seventy or eighty eggs, alleged to have been found in a single nest, are not the produce of one bird, but rather the result of a kind of joint-stock incubating company. Its flesh is eaten by the Indians, and its feathers, from their peculiar structure, make very good hair-brooms.

In the genus Casuarius, the wings are still shorter than in either of the preceding, and seem of no use even in running. They consist, in fact, merely of a few hard, stiff, sharp-pointed, barbless shafts. The head is surmounted by a bony crest, and the bill is laterally compressed (see Plate CCCXCIX. fig. 2). The sole species is the common cassuary (*C. galeatus*, Vieil.), a bird first imported to Europe by the Dutch in 1597. Like the rest of its tribe, it is extremely large, measuring about five feet in height. Its plumage is very peculiar, being long, narrow, decomposed, and hair-like, and the *plumule*, or short inner feather (which exists in almost all birds except pigeons), is of nearly equal length with the outer portion, so that an appearance is produced of there being a double feather to each quill. The prevailing colour is blackish. The cassuary inhabits the Moluccas, Ceram, Bourou, and especially New Guinea. These birds usually live in pairs, and the female lays three eggs, of a greenish hue, and punctured surface. They run with great swiftness, and defend themselves from dogs and other animals, by kicking like horses. The inner claw is very large and strong.

The emeu, or New Holland cassuary, forms the genus Dromecius of Vieillot. The bill is much depressed, the head feathered, without osseous crest, the throat naked. The claws are of nearly equal length. The general colour is dull brown mottled with dingy gray; the young are striped with black. The plumule is equally extended as in the preceding species. (See Plate CCCXCIX. fig. 6.) Next to the ostrich, the emeu is the tallest bird we know. Its flesh affords admirable eating,—"truly exquisite," says Peron, "and intermediate, as it were, between that of a turkey and a sucking pig." Mr Cunningham compares it to beef, which is also an excellent thing. This bird is widely spread over the southern parts of New Holland and the adjacent islands. It is tamed with great ease, and of late years has frequently bred in Britain.

In the genus Apteryx of Shaw,[1] the bill is slender and of considerable length, the legs short, with three anterior toes, and a posterior spur to represent the hallux. The wings are rudimentary. The only known species was obtained a good many years ago on the south coast of New Zealand, by Captain Barclay of the ship Providence, and was presented by him to Dr Shaw. It equals a goose in size. This bird, of which the history was long obscure, has been recently received in London.[2]

The last ornithological form to which we shall allude under our present tribe is the mysterious Dodo (*Didus ineptus*), a bird which some regard as an extinct, others as a fabulous, species. In neither supposition would it fall within the limits of our present treatise, which seeks to present a sketch, however imperfect, of living nature; and we shall therefore not occupy our narrow limits by a subject of "doubtful disputation," on which we cannot ourselves throw any light, having neither been in the Mauritius, nor studied the works of Clusius and the early Dutch navigators.[3]

Tribe 2d.—Pressirostres.

This tribe consists of the bustards, plovers, and other species which, like all the preceding, either want the hind toe, or have it so short as not to touch the ground. The bill is of medium size, but of sufficient strength to pierce the ground in search of worms and insects, the feebler

[1] *Naturalist's Miscellany*, pl. 1057-8.

[2] Yarrell, in *Zool. Trans.* i. pl. 10.

[3] Whoever desires it, will find a summary view of authorities regarding the dodo, by Mr T. S. Duncan, in the *Zoological Journal*, No. xii. p. 554.

species often frequenting moist meadows and tilled ground in search of food. The stronger billed kinds feed also on grain, &c.

The genus Otis, Linn., possesses the bulky massive form of the gallinaceous order, and the upper mandible is somewhat arched; but the bare space above the tarsus, the want of the hind toe, and the general structure both outward and internal, connect them more closely with the Grallatores. The great bustard (*Otis tarda*) is the largest of the European birds, and one of the rarest of our British species. It sometimes weighs nearly thirty pounds, and is now believed to be confined exclusively to Norfolk. We have another species called the little bustard (*O. tetrax*), also very rare. Many fine species occur in Africa and the East. (See Plate CCCXCIX. fig. 4.)

The genus Charadrius, Linn., likewise wants the hind toe. The bill is compressed, and somewhat enlarged towards the tip. It contains the various species commonly called plovers, and may be divided into two. 1*st*, Œdicnemus, Temm., in which there is an inflation towards the terminal portion of the bill in both mandibles, and the nasal fossæ are less prolonged. These are the larger species, of which the great plover (*Œdic. crepitans*), or thick-knee'd bustard of our English writers, affords a good example. It is a migratory bird, of rare occurrence, confined chiefly to our southern and eastern counties, which it visits about the end of April. It is as yet unknown in Scotland. This bird is a nocturnal feeder, and preys principally upon insects. 2*d*, Charadrius, in which the bill is inflated only above, and two thirds of its length on each side are occupied by the nasal fossæ, which renders the organ comparatively feeble. The species are gregarious, and, like the gulls, beat the moist soil with their pattering feet, to terrify the incumbent worms. "The members of this genus," says Mr Selby, "are numerous, and possess a very wide geographical distribution, species being found in every quarter of the globe. Some of them, during the greater part of the year, are the inhabitants of open districts and of wild wastes, frequenting both dry and moist situations, and only retire towards the coast during the severity of winter. Others are constantly resident upon the banks or about the mouths of rivers, particularly where the shore consists of small gravel or shingle; such are most of the smaller species. Except during the season of reproduction, most of them live in societies, larger or of less amount, according to the species. Their migrations are also performed in numerous bodies, the old birds usually congregating by themselves, and preceding the young in their periodical flights. They run with much swiftness, as might be expected from the simple structure of their feet; and from the shape and dimensions of their wings, they fly with strength and rapidity. They live on worms, insects, and their larvæ, &c. and most of them are nocturnal feeders, as indicated by their large and prominent eyes. They are subject to the double moult, and the change at the different seasons is in many species very marked. Their nest is on the ground, and their eggs are always four in number. The flesh of the larger species, and such as inhabit the plains of the interior, is delicate and high flavoured; but in many of the smaller kinds, that live on the coast, or on the banks of rivers, it is not so palatable."[1] The beautiful golden plover (*Char. pluvialis*) is the best-known example to which we need refer. The prevailing plumage of the upper parts is brownish, or very deep hair-brown, each feather being tipped and otherwise spotted with yellow. The chin and throat are white, the fore part of the neck, breast, &c. ash-gray, streaked with darker gray, and tinged with yellow. During the breeding season, the cheeks, chin, throat, fore part of the neck, centre of the breast, and abdomen, are of an intense black, and in this state it has been erroneously regarded as a distinct species. To the same group belong the dotterel (*Char. morinellus*), the ring-plover (*Char. hiaticula*), and many other kinds, exotic and indigenous. Several of the foreign plovers have sharp spurs upon the anterior margin of the wing, as well as fleshy flattened lobes upon the head.

The genus Vanellus of Bechstein differs but little from the plovers, except in the possession of a small hind toe. We here place our elegant crested lapwing, or green plover (*V. cristatus*), commonly called in Scotland the *pees-weep*. The gray plover (*C. squatarola*, Linn.) forms the genus Squatarola of Cuvier, distinguished, like the preceding, by a very small hind toe; but the bill is more bulged beneath towards the extremity, and the nasal fossæ are short.

The genus Hæmatopus, Linn., commonly known by the name of oyster-catcher, has the bill rather long, straight, pointed, compressed. The hind toe is wanting. Our British species (*H. ostralegus*), breeds along the rocky ledges of friths and bays, and is said to open oyster and other shells by means of its bill. We could never detect it in the performance of this feat, and we rather doubt the fact, till assured of it by a credible eye-witness. Oysters are by no means easily opened, even with a knife. Several nearly allied species have been discovered of late years in Asia, Africa, and America. One is found in New Holland.

In the genus Cursorius the bill is slender, rounded, somewhat arched, without furrow. The legs are long, the hind toe wanting. Five or six species occur in Africa and Asia, and of these, *C. Isabellinus*, Meyer, sometimes accidentally appears in the south of Europe. A few specimens have been even seen in Britain.

The genus Microdactylus, Geoffroy (*Dicholophus*, Illiger), has the bill stronger and more curved, with a wider gape. The legs are of great length, the toes slightly palmated at the base, the hinder one very small, and not reaching to the ground. The only known species is a singular South American bird called the *çariama* or crested screamer (*M. cristatus*, Geoff.,—*Palamedea cristata*, Gm.). It is larger than a heron, the plumage reddish gray waved with brown, the forehead ornamented by a crest of recurved slender feathers (see Plate CCCXCIX. fig. 8). The plumes of the head and neck are also decomposed. The çariama inhabits elevated plains in Brazil and Paraguay, where it feeds on serpents and other reptiles, as well as on insects and their larvæ. It flies feebly, owing to the shortness of its wings, but runs with considerable swiftness. When pursued, it is apt to conceal itself by squatting in some cunning corner. Its flesh affords excellent food, and it is sometimes reared by the Spaniards in a domestic state. The female lays only two eggs.

Tribe 3d.—Cultrirostres.

In this tribe the bill is usually strong, of considerable length, straight, cutting, sharp-pointed. In many species the trachea undergoes a peculiar duplication in the male sex. The cæca are short. Cuvier divides the tribe into three lesser groups,—the *cranes*, the *herons*, and the *storks*.

The cranes properly so called (genus Grus) have the bill longer than the head. The most noted species is the common crane of Europe (*G. cinerea*), a migratory bird,

[1] *British Ornithology*, vol. ii. p. 230.

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well known in Britain during former ages, and still breeding in the northern and eastern countries of Europe.

> Part loosely wing the region, part more wise,
> In common, ranged in figure, wing their way,
> Intelligent of seasons, and set forth
> Their airy caravan high over seas
> Flying, and over lands with mutual wing,
> Easing their flight; so steers the prudent crane
> Her annual voyage, borne on winds, the air
> Flotes as they pass, fann'd with unnumber'd plumes.

In our own island the appearance of this bird now-a-days may be regarded as accidental. It is a very large species, measuring above four feet in height. The prevailing plumage is of a deep ash-gray, the face and throat black, the rump and tertial feathers very long, loose, flowing, decomposed.

The whooping crane of the new world (*Grus Americana*) has a pure white plumage, with black primaries. (See Plate CCCC. fig. 1.) This stately bird, when standing erect, measures nearly five feet in height, and is the largest of the feathered inhabitants of the United States (bating Lynch law and the use of tar). It is widely spread over North America, from which it usually retires in winter to the West Indies, although a few hybernate in the warmer parts of the Union, or even linger throughout that inclement season in the swamps of New Jersey, near Cape May. When wounded this crane defends itself with vigour, and has been known to strike its bill through a person's hand with the strength and sharpness of a dagger. It builds upon the ground, and sometimes congregates in vast flocks, the clamour of which is more easily imagined than described. It was heard with astonishment by Captain Amidas, the first Englishman who ever landed in North America, when he visited the island of Wokokou, off the coast of North Carolina. "Such a flock of cranes," says he, "(the most part white) arose under us, with such a cry, redoubled by many echoes, as if an army of men had shouted all together." The bustle of their great migrations, and their passage, as of mighty armies, fill the mind with wonder. Mr Nuttall, while descending the Mississippi in December, observed the whooping cranes in countless thousands, as if assembled from all the swamps and marshes of the north and west,—as if the entire continent was giving up its quota to swell the mighty host. Their flight took place during the night, down the great aërial valley of the river, whose southern course conducted them every instant towards more genial climes. "The clangour of these numerous legions passing along, high in the air, seemed almost deafening; the confused cry of the vast army continued with the lengthened procession, and as the vocal call continued nearly throughout the whole night without intermission, some idea may be formed of the immensity of the numbers now assembled on their annual journey to the regions of the south." Several other fine cranes inhabit America, as well as Africa, and the East.

The beautiful Balearic crane (*A. pavonina*, Linn.) belongs to the genus ANTHROPOIDES of Vieillot. (Plate CCCXCIX. fig. 9.) It occurs in Africa and in some of the Mediterranean islands. The *Demoiselle* (*A. virgo*), remarkable for its peculiar and what may be almost called *affected* gestures, is nearly allied. It is likewise of African origin, as is also the Stanley crane (*Anth. Stanleyanus*), belonging to the same restricted group, and more recently described by Mr Vigors.[1]

In the genus PSOPHIA, which contains the South American trumpeters, so called from their peculiar voices, the bill is less elongated, and the head and neck clothed with short down-like feathers. *P. crepitans* is easily domesticated, and becomes much attached both to places and to persons. It is even said to act as a guard or conductor to domestic poultry. It flies indifferently, but runs with great swiftness. (Plate CCCXCIX. fig. 7.) There are only two species.

The genus ARAMUS of Vieillot is constituted by the *courliri* of Buffon, or scolopaceous heron, of which the bill, slenderer and more deeply cleft, is inflated towards the tip. The toes, all rather long, have no palmation. The only known species (*Ar. scolopaceus*) inhabits Cayenne, Brazil, and Paraguay, spreading into Florida and other southern parts of the Union. It is a shy and solitary bird, dwelling in pairs, and crying in a loud sonorous voice, continually by night and day, *carau, carau.* It runs swiftly, and builds upon the ground, but often lights on trees. It is not fond of wading.

A still more singular bird, classed by Linnæus with the herons (*Ardea helias*), is the caurale snipe of Latham, which now forms the genus EURYPYGA of Illiger. "C'est un oiseau," says Cuvier, "de la taille d'un perdrix, à qui son cou long et menu, sa queue large et étalée, et ses jambes peu élevées, donnent un air tout différent de celui des autres oiseaux de rivage. Son plumage, nuancé par bandes et par lignes, de brun, de fauve, de roux, de gris, et de noir, rappelle les plus beaux papillons de nuit. On le trouve le long des rivières de la Guiane."[2]

The second group of the cultrirostral tribe, composed chiefly of the herons, is more strictly carnivorous than the preceding.

The first genus is CANCROMA, Linn., composed likewise of a single species called the boat-bill—*C. cochlearia.* The bill is comparatively short, but very broad, boat-shaped, with the upper mandible overlapping the lower. It inhabits the moist hot regions of South America, frequenting the banks of rivers, preying on fish, and building its nest on low bushes. It is of an irritable passionate nature, and when enraged raises the feathers of its crest, so as to alter its usual aspect surprisingly. As it scarcely ever frequents the sea-coast, its alleged propensity to feed on crabs is probably ill founded. The boat-bill varies considerably in plumage, but it does not appear that there is more than one authentic species.

The genus ARDEA, Cuv., contains the true herons. The bill is as long or longer than the head, strong, hard, straight, compressed, sharp-pointed; the masticating edges sharp, the culmen rounded. The eyes are encircled by a bare skin, which extends to the base of the bill. The herons form a considerable group, almost all of which, according at least to our particular taste, are remarkable for beauty of plumage. They seldom, however, exhibit a preponderance of the brighter or more gaudy colours, such as red or yellow, being chiefly distinguished by a delicate harmonious blending of pearly-gray and brown, black, white, pale blue, slate-colour, and other sober hues. The *forms* of the plumage are graceful and elegant. Long pendent plumes frequently ornament the hinder portions of the head and neck, the lower part of the breast, and the dorsal region. The body is usually small and light, the limbs long and delicate, the toes narrow and taper, and the neck thin, pliant, and extremely graceful. Many species formerly regarded as true herons are now excluded from the modern genus. The habits of the heron tribe are fully as aquatic as those of the majority of Grallatores. They usually walk, or rather wade, along the shores of lakes, rivers, stagnant marshes, or the land-locked waters of narrow seas, in search of their natural food, which consists of fish, frogs, several marine and fresh-water shells, slugs, worms, and various insects. During flight they extend their legs backwards instinctively, as if to counterbalance the weight of the anterior extremity, and by a duplication of the neck they lower the head between the shoulders. In some instances

[1] *Zool. Journal*, vol. ii. p. 234, pl. viii.

[2] *Règne Animal*, tom. i. p. 509.

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tores.

they are gregarious, in others solitary. In the former case they build in trees,—in the latter, more frequently among reeds or rushes. Several species afford an excellent though now much-neglected article of food, and were not only prized as such in England in the olden time, but were objects of still higher interest and regard, as affording the finest display of strength and intrepidity in the practice of the noble art of falconry. Birds of this genus occur in almost every quarter of the known world. The species which inhabit high northern latitudes, such as Kamtschatka and the shores of Hudson's Bay, migrate southwards before the arrival of winter. Such as breed in warm or temperate climates are more stationary.

Our common or long-necked heron (*Ardea major et cinerea*, Linn.) affords a familiar example of the genus. "Yon Cassius hath a lean and hungry look," yet when examined close at hand he is an elegant and beautifully plumaged species. The heron usually builds on the tops of lofty and umbrageous trees, yet in an island of Loch Conn we have seen its nest on *pollards* not more than ten feet high; and we lately noticed a large heronry among the precipitous cliffs which overhang the sea about a mile outside the entrance to the Cromarty Frith, upon the northern shore. We have several other British herons, the majority of which, however, must be regarded rather as stragglers or accidental visitors, than as truly indigenous species. The egrets are beautiful crested herons, with the plumage usually pure white, and in part decomposed, or very loose and flowing. Of these, the little egret (*Ardea garzetta*, Linn.) is common in Turkey, and the east of Europe, as well as in many parts of Asia, Africa, and the islands of the Mediterranean. It is frequently alluded to in the ancient household books of England; and in the recorded bill of fare of the famous feast of Archbishop Neville, in the reign of Henry IV., a thousand are said to have been served up at a single entertainment. It is indeed extraordinary that a bird now so rare in all the western countries of Europe, should have been at any time so superabundant in Britain; and Dr Fleming has judiciously suggested that the lapwing, which is so beautifully crested, may have been indicated under the old title of *egritte*. The true egret is not even alluded to as an indigenous bird so far back as the time of Willughby and Ray. The great egret (*Ardea egretta*, Temm.) is well known in Poland and Hungary, but scarcely ever shows itself in the western parts of the European continent.

The bitterns have the plumage of the neck extremely full and elongated. Their colours are usually brownish yellow, radiated or spotted with black. They form the modern genus Botaurus. The night-herons constitute another generic group, under the title of Nycticorax. The term, which signifies night-raven, has been no doubt applied from the circumstance of their feeding at night, and remaining in a state of comparative rest and inactivity throughout the day. The European species (*Ardea nycticorax*, Linn.,—*Nyc. Europeus*, Stephens) is more common in America than in the old world. New Holland and Africa each possesses a species. In form, Sir William Jardine observes, these birds are intermediate to the bitterns and true herons; the bill is short, and stronger in proportion than in either, and the hind head is adorned with (generally three) narrow feathers in the form of a crest. They feed by twilight, or in clear nights, and take their prey by wary watching, like the herons. They are gregarious and build on trees, and are noisy and restless during the period of incubation. The prevailing colours are ash-gray and black, or pale fawn and chesnut. The young are always of a dingier hue than their parents, and have their feathers marked with whitish spots.

The remaining genera of the *Cultrirostres* form Cuvier's third group.

In the genus Ciconia, Cuv., the bill is large, without nasal groove or furrow, the nostrils pierced near the base, and towards the dorsal portion. The tarsi are reticulated, and the anterior toes strongly palmated, especially the external. The mandibles are broad and light, and when struck together produce a frequent and peculiar snapping sound, almost the only one they ever utter. The best-known European species is the white or common stork (*Ciconia alba*), a bird somewhat smaller than the crane, but larger than the heron. The bill and legs are red, the whole plumage pure white, except the greater coverts, scapulars, and quill-feathers, which are black. It is a common summer bird in several European countries, especially Holland, where it is esteemed and protected, and has become so familiar as to build on the tops of houses even in the centre of large towns. Its periodical migrations have long excited the admiration of naturalists by their extent and regularity. They are indeed beautifully and wisely directed. "Yea, the stork in the heavens knoweth her appointed times; and the turtle, and the crane, and the swallow, observe the time of their coming." The species appears to have been regarded with peculiar favour in almost all ages and countries. By the ancient Egyptians it was looked upon with a reverence only inferior to that which they paid to the mystical ibis; the same feeling still preponderates in many parts of Africa and the East; while nearer home the Dutch are remarkable for their affectionate attachment to this "household bird." On the other hand, the stork itself appears to reciprocate this friendly feeling. Undismayed by the presence of man, it builds its capacious nest upon the house-top, or on the summits of "ancestral trees" in the immediate vicinity of human dwellings, or even environed by the busiest haunts of men. "It stalks," says Mr Bennet, "perfectly at ease along the busy streets of the most crowded town, and seeks its food on the banks of rivers, or in fens in close vicinity to his abode. In numerous parts of Holland its nest, built on the chimney top, remains undisturbed for many succeeding years, and the owners constantly return with unerring sagacity to the well-known spot. The joy which they manifest in again taking possession of their deserted dwelling, and the attachment which they testify towards their benevolent hosts, are familiar in the mouths of every one. Their affection for their young is one of the most remarkable traits in their character. It is almost superfluous to repeat the history of the female which, at the conflagration of Delft, after repeated and unsuccessful attempts to carry off her young, chose rather to perish with them in the general ruin than to leave them to their fate; and there are many other and well-authenticated proofs of a similar disposition. They generally lay from two to four eggs, of a dingy yellowish white, rather longer than those of the goose, but not so broad. The incubation lasts for a month, the male sharing in the task during the absence of the female in search of food."[1]

Of the foreign species, the gigantic stork (*C. argala*) is well known in India by the name of adjutant. It measures upwards of six feet in height. A nearly allied species is the marabou of Africa (*C. marabou*, Temm.), very common in many parts of the interior. According to Major Denham, it is protected by the inhabitants on account of its services as a scavenger. Its appetite is most voracious, and nothing comes amiss to its omnivorous propensities. Mr Smeathman has given a long account of a bird of this kind which regularly attended at the dining table, and frequently helped itself to what it liked best. It one day darted its enormous bill into a boiled fowl, which it

[1] *Zoological Gardens*, ii. 21.

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swallowed so instantaneously that all hope of rescue was in vain. On another occasion it actually bolted a cat.

The genus MYCTERIA, Linn., contains the birds called *jabirus*. They scarcely differ from the storks, except in the bill exhibiting a slight curvature upwards. The species, if correctly referred to by naturalists, though few in number, inhabit widely distant regions,—*M. Americana* being native to Cayenne, *M. Australis* to New Holland, and *M. Senegalensis* to Western Africa. Is the latter synonymous with Dr Ruppell's saddle-billed stork, *C. ephippiorhyncha*?

The genus SCOPUS is composed of a single species, *S. umbretta*, Linn., an African bird, of the manners of which we are still entirely ignorant. In English books it is called the tufted umber. Its generic title (Σκοπος) is Greek for sentinel. It is probably watchful and solitary.

The genus ANASTOMUS, of which the Pondicherry and Coromandel herons of Latham serve as examples, is peculiar to the East Indies. These species present a remarkable peculiarity in the structure of the bill. The mandibles touch each other only at their points and bases, thus leaving a gaping intervening space. *An. Coromandelianus* is common on the banks of the Ganges, and other eastern rivers, and likewise frequents the Coromandel coast during the months of September, October, and November, feeding on fish and reptiles. A more recently discovered species is *An. lamelligerus* of Temm. (*Pl. Col.* 236), a native of the Cape.

The genus DROMAS of Paykull has the bill compressed and swollen at the base beneath, with the commissures close. The only known species is *D. ardeola*, Temm. *Pl. Col.* 362, an African bird, with white plumage, the back and pinions, as well as the legs and bill, being black. It is of rare occurrence, but rather extended distribution, specimens having been obtained both from the shores of the Red Sea and the Senegal coast. "L'ardeole," says M. Lesson, "tient des œdicnèmes par son bec, et mêmes des sternes, de l'avocette, par son plumage et les tarses. C'est un véritable oiseaux de transition dans l'établissement des familles."[1] Some recent writers regard this bird as identical with the *corrira* so long ago described by Aldrovandi[2] as an Italian species, but not since seen either in Europe or elsewhere. The descriptions however do not accord. Bechstein, Vieillot, and others, think the Italian corrira a fictitious species, made up from the body of an avocet and the legs of a thick-knee'd plover; but Professor Ranzani is of opinion, that as its name is a vernacular one, and there is no proof that Aldrovandi possessed any stuffed birds (none being mentioned in the catalogue of his museum, and the art in those days being almost unknown), a well-known living species must have been alluded to. Indeed it appears that Charleton, at least seventy years after the printing of the Italian author's third volume, received a specimen from Merret of what he considered as the bird in question.[3] "Non vi ha al certo," observes Ranzani, "alcun giusto motivo di rivocare in dubbio, che al tempo di Aldrovandi si trovasse ne' luoghi vallivi del territorio Bolognese un uccello steganopodo, il quali venisse da' cacciatori chiamato corrira, perchè correva velocémente." "E quantunque," he afterwards adds, "oggidì niuno de' molti cacciatori Bolognesi da me consultati conosca la corrira, non cesserò io per questo dal farne le più diligenti ricerche, potendo benissimo accadere, ch'essa torni alcuna volta a visitare i nostri terreni vallivi."[4]

In the genus TANTALUS, Linn., the bill, nostrils, and feet resemble those of the storks, but the back of the upper mandible is rounded, its point curved a little downwards, and slightly notched on either side. A portion of the head, and sometimes of the neck, is bare of feathers. The species, formerly confounded with the ibises, are of large size, and inhabit Asia, Africa, and America. The best known is *Tantalus loculator*, called the wood ibis in the United States. It is white, with the face and head greenish blue, the quill and tail feathers black, with coloured reflections. It measures above three feet in length, and the bill itself is about nine inches long, very broad at the base. The wood ibis is a solitary indolent bird, seldom associating in flocks, but resting alone, like a feathered hermit, listlessly on the topmost limb of some tall decayed cypress, with his neck drawn in upon his shoulders, and his enormous bill resting like a scythe upon his breast. Thus pensive and lonely, he has a grave and melancholy aspect, as if ruminating in the deepest thought; and in this sad posture of gluttonous inactivity (for in truth he has only over-eaten himself) he passes much of his time, till aroused by the cravings of hunger. He feeds on snakes, young alligators, fish, frogs, and other reptiles, and wisely migrates southwards on the approach of winter.[5] In the United States the principal residence of this bird is in the inundated wilds of the peninsula of East Florida. The *Tantalus ibis* of Linn. is an African species, long erroneously regarded as the bird so highly venerated by the Egyptians; but it scarcely occurs in the country of the pyramids, being usually imported from Senegal. The other species of this genus are *T. leucocephalus*, from Ceylon and Bengal; and *T. lactea* (Temm. *Pl. Col.* 352), from Java.

The last genus we shall mention of our present tribe is PLATALEA, Linn., containing the birds called spoon-bills, which, like the preceding, are also few in number. The chief character is constituted by the rounded flat enlargement or dilatation at the extremity of the bill, from which they derive their English name. They inhabit marshy and muddy places, where they grope about with their *spoons* in search of worms and mollusca. They are gregarious and migratory, build on trees, occasionally among rushes, and occur in Europe (*Pl. leucorodia*), Africa (*Pl. nudifrons*), and America (*Pl. ajaja*). The last-named species, called the roseate spoon-bill, is a beautiful bird, the ground-colour white, but richly tinged with rose-colour, deepening in part into carmine-red. The feet are half webbed, and the toes are very long (see Plate CCCC. fig. 2). This bird is more maritime in its habits than the European kind, and wades about the coast in quest of shell-fish and small crabs. According to Captain Henderson (in his account of Honduras), it occasionally both swims and dives. Although it now and then straggles up the Mississippi towards Natchez, into Alabama, and even as far north as the banks of the Delaware, it is a truly tropical bird, frequent in Jamaica and other islands of the West Indies, as well as in Mexico, Guiana, and Brazil. In a southerly direction, it is said to spread as far as Patagonia.

TRIBE 4TH.—LONGIROSTRES.

In this tribe the bill may be characterized as lengthened and feeble. The species belong chiefly to the old genera *Scolopax* and *Tringa* of Linn. They bear a general resemblance in their forms and habits, and frequent moist places, where their slender bills can probe for worms and insects, without the risk of fracture.

In the genus IBIS, Cuv., the bill is long, arched, broad, and squarish at the base, with the point depressed, obtuse, rounded, and the upper mandible deeply furrowed throughout its whole length. The nostrils are narrow and oblong,

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[1] *Traité d'Ornithologie*, p. 591.
[2] *Ornithologia*, t. iii. p. 288.
[3] *Exercitationes de differentiis Animalium*, Oxonii, 1677, p. 102-3.
[4] *Elementi di Zoologia*, t. iii. parte ix. p. 300-2.
[5] Nuttall's *Manual*, vol. ii. p. 83.

and pierced through the membrane of the furrow near its base. The forehead and lores are bare of feathers.

The species of this remarkable genus are distributed over the warmer zones of all the four quarters of the globe, the green or glossy ibis (*Ibis falcinellus*), being itself found in Europe, Asia, Africa, and America, and occasionally in Great Britain. The sacred or Egyptian ibis (*Ibis religiosa*, Cuv.,—*Tantalus Ethiopicus*, Latham) is a bird of a more striking and peculiar aspect, though undistinguished by much diversity in the colours of its plumage. It measures about two feet six inches in length. The head and neck are, in the adults, bare of feathers, presenting nothing but a dark cutaneous surface. The prevailing colour is white, with long funereal-looking plumes of a purplish black colour, proceeding from beneath the tertiary wing-feathers, and hanging down not ungracefully on either side. The legs and feet are deep lead-colour. Among the ancient Egyptians, a people prone to award divine honours to the brute creation, the ibis was regarded as an object of superstitious worship, and its sculptured outline frequently occurs among the hieroglyphical images which adorn the walls of their temples. The conservation of its mystical body occupied the assiduous care of their holiest priests while living, and exercised the gloomy art of their most skilful embalmers when dead. To slay or insult it would have been deemed a crime of the darkest hue, and sufficient to call down upon the offender the immediate vengeance of heaven. The incarnation of their gods was effected through the medium of this sacred bird, and the tutelary deity of Egypt was supposed to be thus imaged to the eyes of adoring mortals when he descended from the highest heavens. The embalmed bodies of this species are still found in the catacombs, and other places of ancient sepulture; and the antiquary and the naturalist marvel alike at the wonderful art which, for some thousand years, has handed down unimpaired to a far-removed posterity the form and features of so frail a creature. The perfection of an unknown process has almost defied the ravages of time, and through its intervention the self-same individuals exist in a tangible form, which wandered along the banks of the mysterious Nile in the earliest ages of the world, or "in dim seclusion veiled," inhabited the sanctuary of temples, which though themselves of most magnificent proportions, are now scarcely discernible amid the desert dust of an unpeopled wilderness.

The natural and mythological histories of this remarkable bird are so closely combined by ancient authors, that it is scarcely possible to gather from their statements any rational meaning. Those, indeed, whose province it is to illustrate the history of mankind, by explaining the rise and progress of superstition, and the frequent connection between certain forms of a delusive worship, and the physical conditions of clime and country, may find in the distorted history of Egyptian animals an ample field for the exercise of such ingenious speculations; but the Zoologist has to do rather with things as they are, than as they were supposed to be,—and his province is to explain (or attempt so to do) the works of the God of nature as they exist in their most beautiful and harmonious simplicity, undeformed by the multitudinous fables of a remote antiquity. We need not, then, to inquire whether the basilisk be born from an egg produced in the body of the ibis, by a concentration of all the poison of all the serpents which it may have swallowed in the course of a long and reptile-eating life;—nor whether the casual touch of its lightest plume still suffices not only to enchant and render motionless the largest crocodile, but even to deprive it at once of life;—nor whether the ibis itself, according to an expression of the priest of Hermopolis, sometimes attains to so great an age that "it cannot die," unless when, removed from the sustaining soil of its beloved Egypt, it sinks beneath the *nostalgia* of a foreign land! For we know that the basilisk does not exist; that young ibises have been seen flapping themselves across the outstretched bodies of sleeping crocodiles, which afterwards sought the waters of the Nile with their accustomed alacrity; and that the age of the sacred bird, though from the skill of the embalmers it may be said to be "in death immortal," does not exceed that of the rest of its congeners.

The sacred ibis is usually observed either in pairs, or in small groups of eight or ten together. They build their nests on palms and other elevated trees, and lay two or three whitish eggs. They do not breed in Egypt, but arrive in that country when the waters of the Nile begin to swell. This apparent connection (as of cause and effect) between the presence of these birds and the fertilizing flow of the mighty and mysterious river, probably gave rise to their worship as divine agents in immediate connection with those grander processes of nature by which the surface of the earth was regulated, and sustained in a fit condition for the health and prosperity of the human race. A slight knowledge of natural history would indeed have sufficed to show, that such divine honours had not been awarded as a consequence of their destruction of serpents and other venomous reptiles; for the modern Egyptians confirm the views of Colonel Grobert, that the ibis does not prey on serpents at all, but feeds very much after the manner of the curlew, on insects, worms, small fishes, and molluscous animals.[1]

A smaller sized though much more splendidly attired species, is the scarlet ibis (*I. ruber*) of America. This brilliant bird is confined to the new world, where it is chiefly tropical, abounding in the West Indies and the Bahama Islands, and stretching southwards of the equator at least as far as Brazil. In the course of the summer (generally in July and August) it migrates into Florida, Alabama, Georgia, and South Carolina, retiring into Mexico and the Carribbean Islands on the approach of the winter season. It is gregarious, feeding along the sea-coast, the shores of estuaries, and the banks of rivers, on small fry, shell-fish, insects, and worms. Although they often perch on trees (where the contrast of their fiery plumage with the surrounding foliage is said to produce a most resplendent effect), they build their nests upon the ground. The young for several seasons exhibit obscure shades of brown, they afterwards become spotted with red, and then assume the splendid attire of the parents, which is a uniform and dazzling scarlet, with the exception of the extremities of the first four primaries, which are of a rich bluish black. Pennant says that the scarlet ibis has been domesticated in Guiana; and Dr Latham possessed one which was brought alive to England, and lived for some time with his poultry. It is clear from the statements of American writers, that it is, at least in temperate countries, a bird of passage, although Cuvier observes, "que cette espèce ne voyage point." When taken young it is easily tamed, and submits to domestication without repining. Delact says it has even propagated in captivity; and M. Delaborde has given the history of an individual which he kept for above two years, feeding it on bread, raw or cooked meat, and fish. It was fond of hunting in the ground for worms, and was in use to follow the gardener in expectation of that favourite food. It roosted at night upon the highest perch in the poultry-house, and flew out at an early hour of the morning, sometimes to a great distance from home. Our climate is probably too cold and variable for a bird which

[1] Wilson's *Illustrations of Zoology*, vol. i. pl. xix.

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on the approach of winter always migrates southwards, otherwise it would assuredly form a splendid (it is even said a savoury) addition to our stock of domestic fowls.[1]

In the genus NUMENIUS, Cuv., the bill is arched, as in the preceding, but still more slender, and rounded throughout its entire length, instead of being square at the base. The extremity of the upper mandible extends beyond the under one, and projects a little over it at the base. There is an obvious palmation at the root of the toes.

To this genus belong the curlews,—well-known birds, of shy and wary habits, which, according to the season, haunt either the hilly pastures or the sandy shores. The North American species (*N. longirostris*, Wilson) is remarkable for the extraordinary length of its bill. (See Plate CCCC. fig. 3.) The common curlew of Britain (*N. arquata*) seems to inhabit exclusively, during the breeding season, our upland moors and pastures, and descends to the sea-coasts in winter. The smaller British species, called whimbrel (*N. phæopus*), seems scarcely known in England during summer, but is then frequent in the north of Scotland, where it breeds. It is distinct from any of the American curlews,—with one of which, however, it has sometimes been confounded. A nearly allied species, first described by M. Vieillot under the title of *Numenius tenuirostris*, as a native of Egypt, has been ascertained by C. L. Bonaparte to exist in great numbers along the banks of the Tiber, where it occurs during winter. It has also been discovered by Signor Savi in the neighbourhood of Pisa, by Dr Pajola in the Venetian territory, and by Professor Bonelli in Piedmont. We doubt not it occurs occasionally in most parts of Europe (especially the eastern countries), although it escapes detection in consequence of its strong resemblance to the common whimbrel. Its distinctive phrase is—Numenius pileo cicerino e nigro maculato: pennis longioribus ilium candidis, immaculatis.[2] The small esquimaux curlew (*N. borealis*, Lath. and Richardson) passes over a vast extent of territory in its migrations,—breeding in the barren lands within the arctic circle, and spending the winter in Brazil.

In the genus SCOLOPAX, Cuv., containing the snipes and woodcocks, the bill is very long, but straight, and pervaded almost throughout its entire length by a nasal furrow. The upper mandible is slightly inflated at the tip, which is rather soft, and extremely delicate in its perceptions. The feet are not palmated. The head is compressed, the eyes large, and situate far back upon the head,—" ce qui," says Cuvier, " leur donne un air singulièrement stupide, qu'ils ne démentent point par leurs mœurs." Now, though the birds in question may want those accommodating instincts which elevate the character of many other species almost into a semblance of reason, we are not aware that they are in any way of defective intellect, that is, that their proceedings are at all discordant with self-preservation, the enjoyment of their natural propensions, or the continuance of their kind; and as to the position of the eye, whatever may be its physiognomical effect, is it not admirably adapted to their general modes of life, and their particular habit of plunging their bills into the mud of marshes, enabling them so to do, and yet to keep a sharp look-out around them? Depend upon it, their eyes are in the right place, and their large size cannot be otherwise than advantageous to birds which feed by night.

We have five British species of *Scolopax*, of which the woodcock (*S. rusticola*) is the chief, a bird much admired by epicures, who eat him, entrails and all,—a dirty practice, we opine: but, *de gustibus non disputandum est*. During the day this species usually frequents the closest brakes, where the ground, from depth of shade, is nearly free from herbage. They abound most in thickets by the sides of open glades, or where roads intersect; for by these they pass to and from their feeding ground at evening and the dawn of morn. " Unless disturbed," says Mr Selby, " they remain quietly at roost upon the ground during the whole day; but as soon as the sun is wholly below the horizon, they are in full activity, and taking flight nearly at the same instant, leave the woods and cover for the adjoining meadows or open land, over which they disperse themselves, and are fully engaged in search of food during the whole night. Advantage has long been taken of this regular mode of going to and returning from the feeding grounds by the fowler, in those districts where woodcocks are abundant, by suspending nets across the glades, or by the sides of hedges, where they are observed to pass continually; and though the adoption of the fowling-piece has in general superseded the modes of capture formerly practised, great numbers are still taken in this manner in Devonshire and Cornwall. Another method of entrapping woodcocks (as well as snipes) is by the springe, which is set in places where those perforations made by the bill of the woodcock in search of food, and technically called *borings*, are observed to be most frequent. It is formed of an elastic stick, of which one end is thrust into the ground, the other having affixed to it a noose made of horse-hair; the stick being then bent down, this noose is passed through a hole in a peg fastened to the ground, and is kept properly expanded by means of a fine trigger, so set as to be displaced by the slight pressure of the bird's foot. To conduct them to this trap, a low fence of twigs, or of stones placed so closely together as to leave no passage through the interstices, is extended to some distance on each side of the springe, and generally in an oblique direction; over which obstacle, however trifling, it seems the birds never attempt to hop or fly, but keep moving along it, till they approach the part occupied by the noose of the springe: upon attempting to pass through this apparently open space, they displace the trigger, and are almost invariably caught by the noose, and retained by the spring of the stick against the opposing peg. Day being the woodcock's time for repose, it sits very close, and is not easily *flushed;* the sportsman then requiring the aid of the busy spaniel, or the bush in which it is ensconced to be actually beaten by an attendant, before it will take wing. It rises, however, with much quickness, and threads its way through the branches with great rapidity, until the underwood and trees are fairly cleared, when its flight becomes measured, and offers an easy aim to the sportsman. When roused, it seldom flies to any great distance, but alights in the first thicket that attracts its attention, closing its wings, and dropping suddenly down, and in such cases it is not unusual for it to run a little way before it squats. Just before rising, upon being disturbed, or when running, it jerks its tail upwards, partly expanding it, and fully showing the white that distinguishes the under surface of the tips of the tail-feathers. In feeding, the woodcock inserts its bill deep into the earth in search of worms, which are its favourite and principal food. This instrument is most admirably calculated for the offices it has to perform when thus immersed in the soil; for, in addition to its great length, it possesses a nervous apparatus distributed over a great portion of its surface, and especially on such parts as are likely to come first into contact with its prey, giving it

[1] *Gardens and Menagerie of the Zoological Society*. We do not know how it has happened that the wood-cut of the scarlet ibis in the work just referred to is copied into Mr Nuttall's excellent *Manual of American Ornithology*, under the name of wood ibis, *Tantalus loculator*,—a bird which belongs to a different genus.

[2] *Ornitologia Toscana*, tom. ii. p. 324.

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the sense of touch in the highest perfection; and to enable it to secure the object thus detected by the discriminating sensibility of the bill, it is further provided with peculiar muscles (common, I believe, to all the members of the genus), which by compression of the upper or basal part of the bill, are brought into action so as to expand the tips of both mandibles sufficiently wide to lay hold of and draw forth the hidden treasure. The digestion of this bird is rapid, and the quantity of worms it can devour in the course of a night is astonishing. I have known one that consumed at a meal (that is, within the night) more large earth-worms than half filled a garden-pot of considerable size. It may, however, by management, be brought to eat other food; as Montagu mentions one that was induced to feed on bread and milk, by worms cleanly washed being put into a mess of that kind; and by this practice being persisted in, the bird soon acquired a relish for this new sort of aliment, and, with the addition of a few worms, throve well upon it."[1] We have already mentioned that the woodcock is now of frequent and constant occurrence as a breeding bird in several of the northern parts of Scotland.

Our other species of this genus are the common snipe, *S. gallinago*, Linn., which also occurs in the temperate parts of Asia; and the jack-snipe, *S. gallinula*, a winter visitant, which breeds, though sparingly, in the north of Scotland. Besides these, we have as occasional visitants,—the great or solitary snipe, *S. major*, Gmel., which haunts the vast marshes of the north of Europe,—and a species of which only one or two examples have been as yet discovered (it was first shot in Queen's county, Ireland, we believe in 1822), named *S. Sabini*, by Mr Vigors.[2] Although some of these birds have an extended geographical distribution, the great similarity of several species, both in size and plumage, has caused misapprehension. There is now no doubt that the species of Europe and America are quite distinct. The lesser woodcock, *S. minor*, is a beautiful bird, well known in the United States. The brown snipe of Pennant (*S. grisea*, Gmel.) forms the genus Macroramphus, Leach. Its toes are webbed at the base.

The genus Rhynchæa, Cuv., has the bill very similar to that of the snipes and woodcocks, but it is slightly arched towards the tip, and wants the furrow on that part. The toes have no palmation. The species are more richly coloured than their congeners, and, in consequence of their occasional variation, have been as yet but indifferently distinguished. The Cape species so called (*R. capensis*,—*Scol. capensis*, Gm., Plate CCCC. fig. 4), occurs in Java and the East Indies; while *R. variegata*, by some regarded as its young, has been received both from China and the south of Africa. A very distinct species, however (*B. hilarea*), described by M. Valenciennes, has been discovered in South America.[3]

In the genus Limosa of Bechstein, the bill is still longer than among the woodcocks, straight, or even slightly turned upwards, and pervaded by lengthened grooves, although the terminal single groove is wanting. The tip is blunt and depressed. There is a palmation at the base of the outer toes. The general form of the species is more slender, and the legs longer, than in the immediately preceding groups. They haunt more habitually saline marshes and the sea shore.

We here place the birds called *godwits*, of which we have two British species,—the black-tailed godwit, *L. melanura*, Leisler and Temm. (*Scol. ægocephala*, Linn.), and the red godwit, *L. rufa*, Briss. (*Scol. Lapponica*, Linn.). Of both of these birds the synonyms, till lately, were greatly confused, owing to the double moult to which they are subject, and which, producing a remarkable change in the nuptial plumage from that of autumn and winter, led to a corresponding multiplication of names,—each kind being described as two species, according to the season in which it was observed. Although the bill in the godwits possesses much of the general form of that of the woodcocks, it wants the extraordinary plexus of nerves, and therefore does not become rugose by exsiccation after death, but continues smooth and polished. It is also more solid, less flexible, and thicker towards the base. These birds inhabit marshes, and the banks and mouths of rivers, where the mud is soft and deep, and there they probe with their long extended bills in search of worms and insects. When thus engaged, they are frequently seen with their heads entirely under water; and we accordingly find them provided with that peculiar gland above the eye, of which the function appears to be to lubricate and defend that delicate and important organ from the irritating effect of saline waters.[4] The females considerably exceed the males in size. Several fine godwits, distinct from those of Europe, occur in North America; and a semi-palmated species, with a strongly recurved bill (*Scol. terek*, Lath.), is found both in India and Van Diemen's Land, and seems in some of its characters to lead towards the avocets.

In the genus Tringa of Temm., Selby, &c. (*Calidris* and *Pelidna*, Cuv.), the bill equals or is longer than the head, is straight or slightly arched, compressed at the base, the tip blunt, smooth, and dilated, semi-flexible, and furrowed throughout its length. The legs are of medium length, very slim, the feet four-toed, divided to the base, slightly margined, with the hind toe scarcely reaching to the ground.

The elegant and interesting species which compose this rather numerous genus are commonly known by the name of sea-larks or sandpipers, a term likewise bestowed upon the *Totani*. Many of them breed by the margins of lakes and rivers in the interior, although the majority congregate in autumn in numerous flocks along the sea coast. They moult twice a year, and their spring and summer plumage is generally very different from that of autumn and winter. This has occasioned great confusion in the history of several species. The sexes present no great disparity in point of plumage, but the females are of larger size. We coincide in Mr Selby's opinion, that the new genera *Calidris* and *Pelidna*, which Baron Cuvier has proposed in place of *Tringa*, are not so distinct or well defined as to warrant their adoption, being in fact only such slight modifications of form as might naturally be expected in birds placed at the extremes of the group to which they belong, and of which the intimate connection is shown by the intervention of species of intermediate form, leading gradually, almost imperceptibly, from one to the other. Besides, if these two generic groups are adopted, it would appear that *Tringa* would cease to exist as a recognised title, which is surely not in accordance with established rule. The species of our present genus are very widely distributed, and several are identical in Europe and America.

The dunlin or purre, *T. variabilis*, Temm. (*T. alpina* and *cinclus*, Linn.), is a strictly indigenous bird in Scotland, where it breeds both near the margins of our inland waters and along the sea-shore,—residing with us throughout the year. In America it penetrates during the summer season to the utmost habitable verge of the arctic circle, breeding on the desolate shores of Melville Peninsula. It likewise inhabits Greenland, Iceland, Scandinavia, and probably most of the coasts of Europe. We know that at least during winter it frequents the Italian shores. In the southern hemisphere it sometimes wanders as far as the Cape of

[1] *British Ornithology*, vol. ii. p. 110.
[2] *Linn. Trans.* vol. xiv. p. 556.
[3] Ferrussac's *Bulletin des Sciences*, 2d cah.
[4] Selby's *British Ornithology*, vol. ii. p. 94.

Good Hope, and has been met with both in the West Indies and South America. When flying in great autumnal flocks, its aërial movements are extremely beautiful, each individual of the vast assemblage yielding so instantaneously to the same impulsion as to exhibit alternately the upper and the under surface of the body, so that we have for a time a living moving cloud of dusky brown, and then a brilliant flash of snowy whiteness.

The larger species, called the knot (*T. canutus*, Linn.), has also a vast range in a northerly direction. It passes the summer within the arctic circle, breeding in Melville Peninsula, and in Hudson's Bay, as far south as the fifty-fifth parallel. It lays four eggs of a dun colour, spotted with red, upon a tuft of withered grass. The knot winters in Britain, but many proceed much farther south, as we know they occur towards the end of autumn in the Venetian territory. The great mass of the North American knots pass over the United States, and spend the winter within the tropics. The other British species are *T. rufescens*, *Temminckii*, *minuta*, *maritima*, and *subarquata*.

The genus Arenaria, Bechstein, closely resembles the sandpipers of the genus Tringa, but is distinguished by the entire absence of the hind toe. The only known species is the sanderling (*A. calidris*), one of our winter birds of passage, which breeds in the remotest northern regions, forming a rude grassy nest among the desolate marshes, and laying four dusky coloured eggs, spotted with black.

The genus Falcinellus, Cuv. (composed of *Scol. pygmæa*, Linn.), has the bill considerably arched, and the hind toe wanting. The only known species is an African bird, which occasionally makes its appearance in Europe. M. Temminck seems to think it should be regarded rather as a synonym than a distinct actual species.

The genus Machetes, Cuv., bears a great resemblance to *Tringa*, except that there is an obvious palmation at the base of the toes. It contains only one species, commonly called the ruff (*T. pugnax*, Linn.), well known in the Lincolnshire fenns and the London markets (see Plate CCCC. fig. 5). It is a summer bird of passage, arriving in the fenny districts of England in the month of April, and departing towards the end of September. The ruff, as its specific name implies, is a remarkably pugnacious species, a disposition which probably arises from its polygamous habits, in which it differs from its congeners. Some people say there are more males than females. Be this as it may, as soon as these birds arrive, each male fixes upon a small hillock or dry grassy spot among the marshes, where he keeps turning about till he has almost trodden it bare; but the moment a female makes her appearance, a general combat commences, the male birds lowering their heads, expanding their neck-feathers, and flying at each other with the action of fighting cocks. These battles are obstinate and long continued, and whoever proves the victor for the time obtains the female. They disperse at night for the sake of feeding, but every morning soon after daybreak each male returns to his hillock, where the same scenes of rivalry and love take place, and continue till their passionate fervour is abated, towards the end of June. The plumage of the ruff presents an almost infinite variety, scarcely two individuals being ever found precisely the same. The lengthened feathers of the head and neck are produced in spring, and shed towards the close of summer; and during autumn and winter the plumage becomes so different from that of the breeding season, that the birds would not be recognised as the same by any one previously ignorant of such mutation. Their flesh is highly esteemed as a delicate and nutritious food. Though these birds extend northwards as far as Iceland, and the colder parts of Russia, they never visit Scotland, the marsh of Prestwick Car, near Newcastle, appearing to be their British boundary. They occur, though rarely, in North America. Though their natural food is worms and water insects, they fatten soon in confinement on boiled wheat, or bread and milk mixed with bruised hemp-seed.

The genus Heteropoda of Nuttall has the bill straight, rather enlarged and punctate at the extremity, the tarsus of moderate length, the three anterior toes connected at the base by a membrane. Example, *Tringa semipalmata*, Wilson. In the genus Hemipalma, Bonaparte, the bill is much larger than the head, partly arched, dilated, and studded at the tip with minute tubercles. The tarsus is very long, and the toes are usually connected by a membrane as far as the first articulation. The species are called stilt sandpipers, of which *H. himantopus* was discovered by C. L. Bonaparte and Mr Cooper. Both these genera are American.

In the singular genus Eurinorhynchus, Wilson, the bill is short, thin, depressed, spoon-shaped, the tarsi short, slender, reticulated. The only known species is a very rare and remarkable bird, *E. griseus*, native, it is supposed, both to Europe and America.[1] It was formerly classed with the spoon-bills (*Platalea pygmea*, Linn.), though scarcely larger than a sparrow. There is a specimen in the French Museum, which was accidentally killed near Paris. The plumage is gray above, white beneath.

In the genus Phalaropus of Brisson, the bill, though more flattened, resembles that of *Tringa*, but the toes are margined by a broadish membrane. In their habits the species are more aquatic than most of their congeners; for though they cannot dive, they float buoyantly on the surface, or even make their way by swimming with almost the ease of the regularly web-footed birds. The gray phalarope or scallop-toed sandpiper (*Phal. lobatus*, Flem.) is found occasionally in Britain during winter. It breeds habitually within the arctic circle, in Hudson's Bay, among the North Georgian Islands, and along the sterile shores of Melville Peninsula. According to Mr Bullock, it is not uncommon in the marshes of Sunda and Westra, the most northerly of the Orkney Isles. When seen swimming in pools, it is continually dipping its bill into the water, as if feeding on some minute aquatic creature. The plumage varies greatly with the season, and a variety of names have been bestowed in consequence of these mutations. The red phalarope (*Tringa fulicaria*, Linn.) represents the summer plumage. It was seen by our northern navigators on the 10th of June, in latitude 68°, swimming at its ease though several miles from land, but surrounded by mountains of ice.

In the genus Strepsilas, Illiger, the legs are rather low, the bill short, and the toes without palmation as in *Tringa*, but the bill is conical and pointed, with the nasal fissure extending only one half its length. The hind toe nearly touches the ground. The only known species, *St. interpres* (of which *St. morinellus* is the young) is a winter bird of passage on the mainland of Britain, though it breeds and remains throughout the year among the Shetland Isles. The turnstone, as it is vernacularly called, is one of the most generally distributed of birds, being found at some season or other in almost every region of the globe. The English name is derived from its habit of turning over little stones along the shore in search of food, which it is enabled to do by its bill being proportionally stronger and stiffer than that of its congeners.

[1] *Acad. Suec.* 1816, pl. vi.

In the genus TOTANUS, Cuv., the bill is slender, round, pointed, firm, the upper mandible slightly arched, with the nasal groove not extending above half its length. The form is light and active, the legs rather long, the toes webbed at the base, more especially between the outer and middle toe. In birds of this genus, as Mr Selby has observed, the comparatively hard and sharp-pointed bill indicates a corresponding change in habits and economy; so that instead of seeking their food by probing in the sand or softer mud, they search for it along the pebbly banks of lakes and rivers, or the ocean's gravelly shore. Some reside habitually in inland districts, while others prefer the sea-coast, or migrate thither during the autumnal season. The British species are the dusky sandpiper, *T. fuscus*, Leisler; the redshank, *T. calidris*, Bechst.; the green sandpiper, *T. ochropus*, Temm.; the wood sandpiper, *T. glareola*, Temm.; the common sandpiper, *T. hypoleucos*, Temm.; and the greenshank, *T. glottis*, Bechst. Besides which, the spotted sandpiper, *T. macularia* (a very common species in North America), &c. are of occasional occurrence. Regarding the last-named species, Mr Bartram informed Alexander Wilson, that he saw one of these birds defend her young for a considerable time from the repeated attacks of a ground squirrel. The scene of action was on the river shore. The parent had thrown herself, with her two young behind her, between them and the land; and at every attempt of the squirrel to seize them by a circuitous sweep, she raised both her wings in an almost perpendicular position, assuming the most alarming aspect possible, and rushing forwards on the squirrel, which for a time drew back intimidated; but soon returning, was met as before by the affectionate but infuriated bird, her wings and whole plumage bristling up to twice their natural size. This interesting, but, for one of the parties, fearful play, continued for about ten minutes, when the strength of the bird began to flag, and the attacks of the quadruped became more audacious, on which Mr Bartram interfered, "like one of those celestial agents," says Wilson, "who in Homer's time so often decided the palm of victory"! The green-shank (*T. glottis*), though usually regarded as merely a passenger in spring and autumn, is now known to breed in Scotland. It inhabits the northern parts of both continents, but is rarer in the new world than the old. Mr Audubon traced it as far south as the Tortugas, near the extremity of East Florida, and Latham received it from Jamaica. It also occurs in Bengal. Our common red-shank (*T. calidris*) is found occasionally in North America. A large species well known in the western world by the name of *willet*, and characterized by all the anterior toes being conspicuously webbed at the base, forms M. Bonaparte's genus CATOPTROPHORUS. This bird not only wades, but swims. It is the semi-palmated snipe (*Scol. semi-palmatas*) of the older systems.

The genus LOBIPES of Cuvier combines the bill of the preceding genus (*Totanus*) with the lobated toes of *Phalaropus*. We may mention as an example the red-necked phalarope,—*Tringa hyperborea*, Linn. (*Lob. hyperborea*, Cuv.), a species not uncommon among our northern islands, where it swims with great ease,—resembling when in the water a beautiful miniature representation of a duck. It likewise breeds all along the forlorn shores of arctic America, resorting to Hudson's Bay in autumn. Another species (*L. Wilsonii*) seems confined to the new world, where it breeds on the banks of the Saskatchewan, and occurs at least as far south as Mexico. It does not advance to so high a northern latitude as the hyperborean species, being as yet unknown beyond the fifty-fifth parallel. It forms an artless nest within the shelter of some grassy tuft, laying two or three pear-shaped eggs, of a tint between yellowish gray and cream colour, interspersed with small roundish spots, and a few larger blotches of umber-brown towards the obtuser end. It can only be regarded as a straggler in the United States. This bird forms the sub-genus HOLOPODIUS of Bonaparte, the basal web between the inner and middle toe being less than in the preceding species. The synonyms of both are still somewhat confused.

The genus HIMANTOPUS, Brisson, has the bill round, slender, pointed, the nasal furrow extending only half its length. But the principal and most peculiar character consists in the enormous length of the leg and tarsus, from which the species have derived the title of stilts, or long-legged plovers. The toes are united by a basal web, larger on the outer than the inner portion of the foot. These birds have a greater predilection for the borders of the sea, and for brackish lakes, than for the banks of rivers or pure fresh-water lakes. Their movements are rapid on the wing, but their gait is somewhat staggering, from the disproportionate length of their legs. The kind which occurs in Europe (*Him. melanopterus*, Meyer), called the black-winged stilt, has been known to breed in France, and accidentally visits England, but its chief resorts are the great salt marshes of Hungary and Russia. It is often seen in Italy in little flocks in spring, travelling northwards. It likewise occurs in Asia, Africa, and America; but the species of the new world, described by Wilson, is the *Him. nigricollis* of Vieillot. We shall here quote his account of its manners and mode of nidification, as the history of the European stilt, in these particulars, is scarcely known. "This species arrives on the sea-coast of New Jersey about the 25th of April, in small detached flocks of twenty or thirty together. These sometimes again subdivide into lesser parties; but it rarely happens that a pair is found solitary, as during the breeding season they usually associate in small companies. On their first arrival, and indeed during the whole of their residence, they inhabit those particular parts of the salt marshes pretty high up towards the land, that are broken into numerous shallow pools, but are not usually overflowed by the tides during the summer. These pools or ponds are generally so shallow that with their long legs the avocets can easily wade them in every direction; and as they abound in minute shell-fish, and multitudes of aquatic insects and their larvæ, besides the eggs and spawn of others deposited in the soft mud below, these birds find here an abundant supply of food, and are almost continually seen wading about in such places, often up to the breast in water.

"In the vicinity of these bald places, as they are called, fifty yards off, among the thick tufts of grass, one of these small associations, consisting perhaps of six or eight pair, takes up its residence during the breeding season. About the first week in May they begin to construct their nests, which are at first slightly formed of a small quantity of old grass, scarcely sufficient to keep the eggs from the wet marsh. As they lay and sit, however, either dreading the rise of the tides, or from some other purpose, the nest is increased in height with dry twigs of a shrub very common in the marshes, roots of the salt grass, sea-weed, and various other substances, the whole weighing between two and three pounds. This habit of adding materials to the nest after the female begins sitting, is common to almost all other birds that breed in the marshes. The eggs are four in number, of a dark yellowish clay colour, thickly marked with large blotches of black. These nests are often placed within fifteen or twenty yards of each other; but the greatest harmony seems to prevail among the proprietors. While the females are sitting, the males are either wading through the ponds or roaming over the adjoining marshes; but should a person make his appearance, the whole collect together in the air, flying with their long legs extended behind them, keeping up a continual yelping note of *click, click, click*. Their flight is

Grallatores.

steady, and not in short, sudden jerks, like that of the plover. As they frequently alight on the bare marsh, they drop their wings, stand with their legs half bent, and trembling, as if unable to sustain the burden of their bodies. In this ridiculous posture they will sometimes stand for several minutes, uttering a curring sound, while, from the corresponding quiverings of their wings and long legs, they seem to balance themselves with great difficulty.

"This singular manœuvre is, no doubt, intended to induce a belief that they may be easily caught, and so turn the attention of the person from the pursuit of their nests and young to themselves. The red-necked avocet practises the very same deception, in the same ludicrous manner, and both alight indiscriminately on the ground or in the water. Both will occasionally swim for a few feet, when they chance in wading to lose their depth, as I have had several times an opportunity of observing."[1]

The singular birds called avocets form the genus Recurvirostra, Linn. Their feet are almost as fully palmated as those of certain Natatores, yet they are generally classed among the Grallatores, by reason of their lengthened tarsi, and legs bare above the knee. The bill also has the same lengthened, slender, pointed form, and smooth elastic structure, which characterize our present order, with which the birds in question agree in their general mode of life. The character which distinguishes them from all other birds is the extraordinary upward curvature of the bill (see Plate CCCC. fig. 6). The avocets live either in pairs or small companies in the midst of marshes, where they wade about with great ease, and to a considerable depth, in consequence of their bodies being raised so high above the surface. Though web-footed, they do not swim except by compulsion; yet one which Wilson wounded attempted repeatedly to dive, but the water was too shallow for his purpose. They run rapidly, and their flight is powerful and long sustained. Their nests are described as small cavities in the earth, lined with a few weeds, or merely the bosom of the bare sand; sometimes, however, they are raised several inches above the surface, as if to avoid the effects of moisture or inundation. The European species (*R. avocetta*, Linn.) is not uncommon along the eastern coasts of England south of the Humber. It breeds in the fenny parts of Lincolnshire and Norfolk, as well as in Romney Marsh in Kent. They assemble during winter in small flocks, frequenting the oozy shores about the mouths of rivers, where they scoop out small worms and mollusca. Buffon indulges in one of his characteristic vagaries while discussing the singular bill of this bird, which he supposes to be "one of those errors or essays of nature, which, *if* carried a little further, would destroy itself; for *if* the curvature of the bill were a degree increased, the bird could not procure any sort of food, and the organ destined for the support of life would infallibly occasion its destruction." This essay of nature is, however, as it happens, a most successful one; for by means of its lengthened legs and upturned bill, the avocet feeds with facility in muddy marshes, where if otherwise organized it would probably starve. *If* a devoted servant of God, while tonsorially engaged on some beautiful Sabbath morning, were to move the edge of his glittering blade an inch nearer his carotid artery, he would die, leaving behind him, in all probability, a disconsolate widow, and a large family of small children; but as he takes especial care to move his useful weapon in another direction, the artery remains intact, and the crime of suicide unaccomplished. We doubt not that the curvature of the bill in question could not have been better projected even by Buffon himself, although he was addicted in his youth to mathematics. The American avocet (*R. Americana*, Linn., Plate CCCC. fig. 6) has the head and neck pale rufous, and the bill takes a downward curve towards the extremity. Though abundant on the banks of the Saskatchewan, as far as the fifty-third parallel, it does not seem to proceed into the more northern regions. Besides these species, there are the *R. alba* of Latham (*R. orientalis*, Cuv.), from India; and the *R. rubricollis*, Temm., a native of New Holland. Our indigenous species also occurs both in Asia and Africa.

FAMILY V.—MACRODACTYLES.

The prevailing character of this group consists in the extremely long narrow form of the toes, which are without any connecting web. Nevertheless the species run with great ease in moist places, and some of them swim very swiftly. The bill, more or less compressed laterally, varies in length in different genera, but is never so delicately slender as among the preceding family. The body in these birds is much compressed, a form determined in a great measure by the narrow nature of the sternum. The wings are of medium length, or short; and the power of flight, though necessarily efficient in such as are birds of passage, is on the whole restricted, or but sparingly exercised. The posterior toe is of considerable length.

The first genus, called Parra by Linnæus, contains the jacanas, by some named spur-winged water-hens. The bill is rather longer than the head, nearly straight, laterally compressed, and somewhat enlarged both above and below towards the extremity. There is usually a small fleshy shield upon the base of the forehead. The toes are of great length, very narrow, unwebbed, and the claws, especially the hinder one, very long and sharp (see Plate CCCC. fig. 7). The anterior angle of the wing is armed with a spur. The jacanas occur in the warmer countries of the world—in Bengal, Java, the Celebes, China, South America, and parts of Africa. They inhabit marshy places, and run with great facility over the surface of aquatic plants, their long, extended toes spreading over so much space as to prevent their sinking in the water. They feed on insects, build their nests among the moist herbage, and lay four or five greenish eggs spotted with brown. Their flight, though low, is rapid. They are shy and silent birds, except at night, when their voices are often heard among the marshes. The Chinese jacana of Latham (*Parra sinensis*, Gmelin) is found both along the marine shores and the moist plains of the interior. This species, as Mr Gould observes, is distinguished not more by grace and beauty of form, than by its admirable adaptation to the particular localities to which nature has allotted it. Formed for traversing the wide morass, or lotus-covered surface of water, it supports itself upon the floating weeds and leaves by its extraordinary extent of toes and unusual lightness of body. Like our common water-hen, of whose habits and manners it partakes largely, it is no doubt capable of swimming, although the long and pendent tail-feathers seem an inconvenient appendage for such a purpose. Its powers of flight appear deficient, the quill-feathers being terminated by a slender process proceeding from the tip of each shaft. This singular bird has been long known as a native of the low lands of India and other eastern countries, but was not till lately ascertained to occur in the Himalaya, where it inhabits lakes and swamps among the hills.[2] Another eastern species (*P. gallinacea*, Temm. *Pl. Col.* 464) is provided with a crest, but wants the spurs upon the wings.

In the genus Palamedea, Linn., the bill is rather short, conical, compressed, convex, and curved at the extremity. There is a bare space around the eyes, the wings are am-

[1] *American Ornithology*, vol. iii. p. 76.

[2] *Century of Birds from the Himalaya Mountains.*

ple, furnished with strong spurs. The tarsi are short and thick, the toes and claws long. Some systematic writers include in this genus only a single species, *P. cornuta*, Linn., called kamichi or the horned screamer, a South American bird, larger than a goose, with a slender moveable horny projection on the forehead. Though this bird affects inundated places, its toes are without palmation. In its general aspect, and several of its special habits, it exhibits an approach to the gallinaceous order; and although its stomach is but slightly muscular, it lives much on grain and herbage.[1] It is also easily reduced to the domestic state; and although it lays only two eggs, the young speedily follow the parents.

It is by no means easy to conjecture the natural uses of these formidable weapons on the wings of this and several other species. One would suppose them intended to wage war among their kind,—yet the birds so endowed are for the most part peaceable, and aversc to broil and battle,—even in most instances of a timid and fearful nature; and in the case of several of the plover tribe, there is no appreciable difference in the habits of the armed and unarmed kinds. All who have studied the manners of the kamichis agree that they are the gentle inhabitants of moist savannahs, or the shores of those extensive rivers which intersect the southern portion of America, and that there is nothing pugnacious in their temper. Yet they are "doubly armed," the margin of each wing bearing a pair of very large spurs, thick at the base, but tapering sharply to a point, and, no doubt, when driven forcibly forward by the muscular action of a powerful wing, capable of inflicting such a blow as would at once deprive most small animals of life.

Another bird, by some referred to our present genus, is *Pal. chavaria*, Temm. (*Pl. Col.* 219), the *Parra chavaria* of Linn., known in some English works as the faithful jacana. Instead of a horn, its head is ornamented by a feathered crest, and there is an obvious palmation between the outer and middle toes. For these and other reasons it forms the genus CHAUNA of Illiger. Its head and upper neck are clothed with down, the latter being surrounded by a black collar. The rest of the plumage is lead colour and blackish, with a white spot upon the front of the wings, and another on the base of the primaries. Linnæus, on the authority of Jacquin, gives the following history of this bird:—"It inhabits the rivers, lakes, and marshes, near the river Sinu, about thirty leagues from Carthagena, in South America. It feeds on vegetables; its gait is solemn and slow, but it flies easily and swiftly; it cannot run unless assisted by the wings at the same time. When any part of the skin is touched by the hand, a crackling is felt, though it is very downy beneath the feathers; and this down adheres so closely as to enable the bird at times to swim, notwithstanding the length of its legs and of its cleft feet; which latter enable it also to walk on the aquatic plants of the pools. It has two strong and pointed spurs on the bend of the wing, which are, however, hidden when the latter is closed, but when expanded they become formidable weapons, aided by the strong and lengthened wing; and by means of them it is able to drive off birds as big as the carrion vulture, and even that bird itself. The natives, who keep poultry in great numbers, have one of these tame, which goes along with the flock about the neighbourhood to feed during the day, when this faithful shepherd defends them against birds of prey: it never deserts the charge committed to its care, although able to fly, but returns home with them safe in the evening. It is so tame as to suffer itself to be handled by a grown person, but will not permit children to attempt the same. Its voice is clear and loud, but far from agreeable."[2]

Baron Cuvier here places the genus MEGAPODIUS, Quoy et Gaim., of which the bill is slender, straight, flattened, and enlarged at the base, restricted at the centre, and inflated towards the point. The tail is small and wedge-shaped. The general form is massive, the plumage usually brown, without lustre. The species inhabit New Guinea, the Marianne Islands, &c. and are described in the voyages of Freycinet and Duperrey. They are remarkable for the largeness of their eggs. Some authors place them with the genera *Crax* and *Penelope*, rather than in the grallatorial order.

The extensive genus RALLUS, Linn., is in one or other of its forms known in almost every country of the world. With Bechstein, we would restrict the title to such as have the bill longer than the head, rather slender, compressed at the base, with the tip cylindrical, and slightly curved. As a British example may be mentioned our common water-rail (*R. aquaticus*), a shy and solitary bird, which resides throughout the year in Britain. It is extensively spread over Europe, but does not occur in America. The land-rails form the genus CREX, Bechstein, and have the bill shorter than the head, thick at the base, somewhat cultrate, and compressed. The wings are armed with a small concealed spine. Besides the well-known corn-crake (*C. pratensis*), a summer bird of passage, of which the deceptive note is heard so often during evening twilight, we have the spotted crake, *C. porzana*, Baillon's crake, *C. Baillonii* (Olivaceous gallinule of Mont.?), and the little crake, *C. pusilla*. The Carolina rail seems a *Crex* in the form of its bill, though its aquatic habits assimilate it to *Rallus*. It assembles during autumn in vast numbers on the reedy shores of the larger rivers in the middle and southern states of North America, and affords abundant occupation to sportsmen. Any active and expert marksman may kill ten or twelve dozen in a few hours. It winters to the south of the Union. The diet of the different species probably varies with time and place. The American bird just named is very fond of rice. Our own species feed both on grain and insects. Sir W. Jardine found a short-tailed field-mouse in the stomach of a land-rail. This bird is called king of the quails in some continental countries, in consequence of its arriving and departing with these birds.

The old genus FULICA, Linn., has, like the preceding, been also subdivided, in accordance with the form of the bill and lobation of the toes. For example, the genus GALLINULA of Briss. and Lath. has the bill resembling that of *Crex*, but there is a flat fleshy shield upon the forehead. The toes are long, and bordered by an extremely narrow lateral margin. We here place our British gallinule, familiarly known by the name of water-hen, *G. chloropus*, Lath. This bird, though with us a permanent residenter, is migratory in all the more northern parts of Europe. It occurs both in Asia and Africa, but not in America, as some erroneously suppose. It swims and dives well, though its feet might, *a priori*, be deemed but little fit for such aquatic service. The water-hen is of rather familiar habits, that is, a pair are sure to make their appearance as soon as any small artificial piece of water has been formed, even in the closest proximity to human dwellings. It builds by the water-side, and lays a great number of eggs, from eight to ten, which it is said to cover carefully during its occasional absence in search of food. The purple and Florida gallinules (*G. Martinica* and *galeata*) occur in North America; and a Javanese species (*G. ardosiaca*) is described by M. Vieillot.

In the genus PORPHYRIO of Brisson, the bill is higher in relation to its length than in the preceding. The toes are extremely long, with scarcely a perceptible bor-

[1] Bajon, *Mém. sur Cayenne*, t. ii. p. 284.

[2] Shaw's *General Zoology*, vol. xii. p. 272.

Gralla-tores.

der; and the frontal disk, sometimes rounded, sometimes square above, is of considerable size. The species are remarkable for richness of colouring. *P. hyacinthinus*, Temm. (*Fulica porphyrio*, Linn.), is an African species, not unfrequent in Sicily and Sardinia.

The genus Fulica, as now restricted, is chiefly distinguished from its congeners by a scallop-shaped or broadly-festooned membrane on each side of the toes. It contains the coots, of which *F. atra*, Linn., our common coot, affords a good example. This bird, as generally distributed in Britain throughout the summer season as the water-hen, leaves the northern portions of the island on the approach of winter. It dislikes being approached in open water, though a good diver, and quickly betakes itself to some protecting cover of reeds or other water-plants on every slight alarm. The cinereous coot of the western world (*F. Americana*, Gmel.) is a distinct species, though not so regarded by Alexander Wilson. It is widely spread over a vast extent of territory, from the steaming marshes of Jamaica to the cool and grassy lakes which skirt the plains of the Saskatchewan.

Baron Cuvier terminates his systematic exposition of the grallatorial order by three genera of a somewhat anomalous nature, which certainly do not amalgamate either with their neighbours or each other.

The genus Chionis of Forster has the bill short, strong, compressed, the nostrils tubular, and protected by hard, elevated, and compressed folds, which envelope the base. (Plate CCCC. fig. 8.) The front of the head and part of the face are naked, the wings long, the feet short. There is only a single species known. It is called the sheath-bill, *Ch. Forsteri*, or *necrophaga*, or *vaginalis*, and is of snowy whiteness, and of the size of a pigeon. A great diversity of opinion exists regarding its position; some writers removing it into the ensuing order, while Mr Swainson places it among the Columbidæ. It inhabits New Zealand, Kerguelen's Land, Staten Land, and other countries of the southern hemisphere, where it is said to frequent the sea-shore in flocks, feeding on mollusca and carrion, which latter renders its flesh offensive to the taste. It was discovered during Cook's circumnavigation.

The genus Glareola, Gmel., contains the pratincoles, or sea-partridges as they are sometimes called. The bill is short, compressed, somewhat arched throughout, and rather deeply cleft. The wings are of great length, and very sharp pointed, somewhat resembling those of swallows. The legs are of medium length, and there is a slight palmation between the outer and middle toes. The tail is usually forked. These birds fly in numerous noisy flocks, and feed on insects, "particulièrement des mouches et autres insectes ailés qui vivent parmi les joncs et les roseaux; il se lance" (M. Temminck alludes particularly to the European species) "sur ces insectes avec une rapidité étonnante, et les saisit au vol ou à la course."[1] The pratincoles inhabit the temperate and warmer regions of the old world, and are unknown in America. The collared or Austrian species (*G. torquata*, Meyer) is common in the south-eastern countries of Europe, and has been killed occasionally in Britain.[2] *G. lactea*, Temm., inhabits Bengal;[3] *G. grallaria* of the same author is native to New Holland.

Lastly, the genus Phœnicopterus, Linn., contains those extraordinary birds called flamingoes. The bill is higher than wide, dentated, conical towards the point, the upper mandible suddenly bent from its centre downwards upon the under one, which is the broadest. The neck and legs are of extraordinary length, and the anterior toes are united by a broad palmation. Mr Swainson regards this genus as the grallatorial type of the *Anatidæ*, and he consequently places it in the natatorial order, which we are just about to enter. The only species known in Europe is *Ph. ruber*, Linn., a bird well known in Sicily and Calabria, and very abundant in Sardinia, especially among the lagunes and marshes in the neighbourhood of Cagliari. Large flocks occur almost every year along the southern coasts of France, and a few sometimes stray as far northwards as the banks of the Rhine. It is common in many countries of Africa and Asia; but the American species, regarded as synonymous by Wilson, is a distinct kind, mentioned long ago as such by Molina. (See Plate CCCC. fig. 9.) It is the *Ph. Americanus* of Mr Nuttall, and the bird alluded to by Thomas Campbell in his Gertrude of Wyoming:—

> Then, where of Indian hills the daylight takes
> His leave, how might you the flamingo see
> Disporting like a meteor on the lakes.

Another western kind occurs in South America (*Ph. ignipalliatus*, Isid. Geoff.),[4] while a fourth (*Ph. minor*) is native to the Cape and Senegal.[5] These birds in general inhabit solitary sea-coasts in most of the warmer regions of the earth, where they associate in flocks, and migrate in bodies formed into an angular phalanx, like wild geese. They feed upon mollusca, insects, and spawn, which they fish up by means of their lengthened necks, sometimes turning their bill upside down, to take advantage of its peculiar, and apparently inconvenient form. They are said to be extremely shy and watchful (although Dampier and his two companions succeeded in killing fourteen at once[6]), and place sentinels, which on the approach of threatened danger, give alarm by a loud and trumpet-like cry. They also breed together in inundated marshes, raising their nests to a considerable height, by collecting the mud into a pyramidal hillock with their toes, after which they brood and hatch their eggs in what may be called a standing posture, their feet and legs being often in the water. The young are only two or three in number, and run almost as soon as excluded from the shell. They sleep standing upon one leg, with the neck folded back upon the body, and the head reclined beneath the wing. They run swiftly, but never swim from choice.[7] The tongue of the European flamingo was much admired by ancient epicures; and Apicius, that "deepest abyss of wastefulness," as Pliny calls him, is supposed to have been the first to discover its exquisite flavour.[8]

Order VI.—PALMIPEDES, or WEB-FOOTED BIRDS.[9]

The birds of this order are especially characterized by their peculiar adaptation for swimming, their feet being generally short and placed far behind, their tarsi short and compressed, and their anterior toes connected by membranes,

[1] *Manuel*, ii. p. 502.
[2] Bullock, in *Linn. Trans.* xi. 177.
[3] See *Planches Col.* 399;—also Leach in *Linn. Trans.* xiii. pl. 12.
[4] *Annal. des Sciences Nat.* xvii. 454.
[5] Temminck, *Pl. Col.* 419.
[6] *Voyage*, i. 70.
[7] Nuttall's *Manual*, ii. 70.
[8] On concluding this portion of our present treatise, domestic circumstances, with which it does not concern the reader to become acquainted, but which the author could not control, rendered impossible the continuance of his own labour. The sketch of the ensuing (natatorial) order was therefore kindly undertaken by Mr Macgillivray, whose well-known acquirements in Ornithology will render the substitution advantageous to the public.
[9] Natatores, Illiger.

Palmipedes.

or inlayed by lateral lobes. Their plumage is close, often glossy, and imbued with an oily fluid, which repels the water; and their skin is moreover covered with a dense layer of down, which prevents the rapid escape of the heat generated in their bodies. They are the only birds whose neck exceeds their legs in length, the reason of which arrangement is, that while swimming on the surface of the water they have often to search for their food at some depth. Their sternum is elongated so as to cover the greater part of the viscera, and has only a lateral notch, or oval foramen, so that a large surface is afforded for the insertion of the pectoral muscles. Their œsophagus is always wide, their gizzard generally muscular, and their intestine furnished with two rather long cæca. Their windpipe varies in form, but the inferior larynx is simple, although in one family it has a curious bony and cartilaginous dilatation.

This order has been divided into four families:

1. The *Brachypteræ*, or short-winged sea-birds, having the wings very short, and the feet placed so far behind that they are obliged to assume a nearly erect posture when on shore.

2. The *Longipennæ*, or long-winged sea birds, having the wings extremely long, the hind toe free or wanting, and the bill horny.

3. The *Totipalmæ*, of which the hind toe is connected with the rest by a common web, the wings long, and the bill horny.

4. The *Lamellirostres*, whose bill, which is thick and covered with a soft skin, has the edges furnished with transverse horny plates or teeth.[1]

FAMILY I.—BRACHYPTERÆ, OR DIVERS.

The organization of these birds renders them more aquatic than those of any other family. Many of them reside almost entirely on the waters, fly little, and walk with difficulty, their feet being placed very far behind. Their wings are generally extremely short, and their flight, although sometimes rapid, is neither undulated nor buoyant. In some species they are reduced to mere organs of natation, the quills not being developed. All the species are furnished with a dense and short plumage, swim and dive with remarkable agility, and pursue their prey under the surface, employing their wings as well as their feet to aid their progress. They are generally distributed, migrate extensively, and breed in society, often on rocky islands or abrupt cliffs. This family may be divided into three tribes.

1*st.* The divers,—*Colymbidæ*, are characterized by their straight, compressed, pointed, smooth bill, linear and lateral nostrils, narrow wings, and short tail. In some the feet are lobed, in others webbed.

The grebes, genus Podiceps (Plate CCCCI. fig. 1), resemble the coots in the form of their feet, their anterior toes, instead of being connected by webs, being merely dilated by means of lateral lobes. Their body is generally short and depressed; their neck long and slender; their bill straight, compressed, tapering, and pointed; their nostrils linear and pervious. The legs (tibiæ) are entirely concealed in the abdomen; the tarsi are extremely compressed; and the claw of the middle toe is flattened and dilated. The plumage is remarkably soft, silky, and often, especially on the lower part, has a shining gloss. Their wings are very narrow, and their tail is generally reduced to a slight tuft of scarcely distinguishable feathers. These birds when on shore are obliged to stand in a nearly erect posture; but although they walk with difficulty, their flight is rapid, and their motions on the water extremely quick. They dive and pursue their way under water with extreme agility, and when apprehensive of danger generally disappear under the surface, instead of flying off. Their food consists of small fishes, crustacea, mollusca, and insects, as well as seeds of aquatic plants; and they nestle in marshy places, laying several eggs, generally of a white colour. Their plumage varies so much, according to age and sex, that the species have been erroneously multiplied by authors. Four species inhabit Europe, of which two may be particularly mentioned.

The great crested grebe, *Podiceps cristatus*, is of the size of a mallard, blackish brown on the upper parts, with a white band on the wing, and of a silvery white beneath. The adults have a double black crest, and a large reddish ruff or tippet margined with black, on the upper part of the neck. This species inhabits the northern part of both continents, where it breeds, and whence it migrates southward on the approach of winter. The nest is made of rushes and flags, or other aquatic herbage; and the eggs, three or four in number, are of a greenish white. Several authors allege that the female sometimes succours her young, when fatigued or in danger, by carrying them on her back or beneath her wings. From their surprising agility in diving they are not inappropriately named water-witches and dippers in America. The skins are dressed and made into muffs and tippets.

The little grebe, or dobchick, *Podiceps minor*, is the smallest of the species, not exceeding ten inches in length. It is not uncommon in most parts of Europe, as well as in the north of Asia, and the country around Hudson's Bay. In large rivers and lakes individuals are said to be sometimes devoured by pike and other fishes. In the adult the upper parts are deep black, the lower silvery gray, the throat black, and the neck ferruginous.

The finfoots, Podoa, Illig., have the feet lobed like the coots and grebes; but their tail is more developed, and their claws more pointed. (Plate CCCCI. fig. 2.) To this genus have been referred the African finfoot, *P. Senegalensis*, and the Surinam species, *P. Surinamensis*, which latter, however, is by some considered as belonging to *Anhinga*.

The divers properly so called, genus Colymbus, greatly resemble the grebes in form, but differ from them in having the toes regularly webbed, and the tail moderately developed. Their body is elongated, and somewhat depressed; their neck long, their head small, oblong, and compressed; their bill rather long, straight, and tapering to a point; their plumage short and close; their wings of moderate length, but very narrow. These birds are peculiarly aquatic, and while in search of food remain often longer submerged than on the surface, to which they seem occasionally to come merely for the purpose of respiring. They feed on fishes of various kinds, but generally of small size, as well as on crustacea. Like the grebes, they dive when alarmed, and are not easily raised from the water, although their flight, which is direct, is very rapid. On land they stand erect, and walk with difficulty. They are generally solitary, breed on the margins of lakes in the arctic regions, and lay two or three very elongated, dark-coloured, and spotted eggs. Their flesh is dark-coloured and unsavoury. Of this genus the more remarkable species are the following.

The great northern diver, *Colymbus glacialis*, is about two feet and three quarters long, with the upper parts black, spotted with white; the head and neck glossy black, with green reflections, the lower parts white; the tail has twenty feathers. This species is generally distributed in

[1] For some interesting general observations on certain genera of this order, the reader may consult "Remarks on the Pelagic Birds, and on certain other Palmipedes, considered especially as regards their habits and their geographical distribution in the Oceans of the Globe," published in Freycinet's *Voyage autour du Monde,—Partie Zoologique*, par MM. Quoy and Gaimard.

the cold and temperate climates of the northern hemisphere. It breeds in the arctic regions, generally on the margin of lakes, or on islands, laying three eggs of a dull olive tint spotted with dusky. "Far out at sea in winter," says Nuttall, "and in the great western lakes, particularly Huron and Michigan, in summer, I have often heard, on a fine calm morning, the sad and wolfish call of the solitary loon, which like a dismal echo seems slowly to invade the ear, and rising as it proceeds, dies away in the air. This boding sound to mariners, supposed to be indicative of a storm, may be heard sometimes for two or three miles, when the bird itself is invisible, or reduced almost to a speck in the distance. The aborigines, nearly as superstitious as sailors, dislike to hear the cry of the loon, considering the bird, from its shy and extraordinary habits, as a sort of supernatural being. By the Norwegians its long-drawn howl is, with more appearance of reason, supposed to portend rain." The flesh of this bird is dark and unpalatable; but its skin, with the feathers on, is used by various barbarous tribes as an article of clothing.

Two other species, of inferior size, the red-throated diver, *C. septentrionalis*, and the black-throated, *C. arcticus*, inhabit the same regions, and are nearly similar in habits. Both these birds breed in some of the northern parts of Scotland.

The guillemots, genus Uria, have the bill of moderate length, robust, straight, compressed, and pointed; the nostrils nearly basal, lateral, linear, and partially covered by short feathers. The head is rather large and oblong, the neck short. The legs are placed far back, and their feet differ from those of the divers in wanting the hind toe. Their wings are short, narrow, and pointed; but they fly with considerable speed, and their tail is very short and rounded. These birds migrate in small flocks, and collect in vast assemblages to breed on the abrupt precipices and rocky islands of the northern seas, whence they again retire towards the end of autumn. They form no nest, but deposit their single egg, which is pyriform and of great size, on the bare rock.

The common guillemot, *Uria troile*, is somewhat less than the mallard, and has the bill longer than the head; its upper parts are black, the lower white, as are the tips of the secondary quills; in summer the head is brown, and the adult has a black stripe behind the eye. This species is very abundant along the northern coasts of Europe and America, and nowhere more so than in the British seas.

Another species, about the same size, but distinguishable by having the bill shorter and much more robust, is the thick-billed guillemot, *Uria Brunnichii*, which also occurs in the northern seas of both continents, but does not extend so far south as the former.

The Greenland dove, or little guillemot of authors, has been considered by some as constituting a distinct genus, to which Cuvier has given the name of Cephus. It is about the size of a large pigeon, and is entirely black, excepting a large white space on the middle of the wing, and the feet, which are red. This species, unlike those mentioned above, breeds under stones or in the crevices of rocks, where it lays two or three light-coloured eggs, spotted with dusky. It is frequent in the northern seas, and breeds on the Scottish coasts in great numbers.

2*d*. The auks,—*Alcadæ*, which form the next group, are very closely allied to the guillemots, from which they are easily distinguished by their extremely compressed and vertically elevated bill, which is usually transversely furrowed. The toes are entirely webbed, but the hind toe is wanting, as in the guillemots, which they further resemble in their habits and distribution. This tribe may be divided into several subordinate genera.

The puffins, genus Fratercula, have the bill shorter than the head, and as high at the base as it is long, a circumstance which gives these birds an extraordinary appearance, and has given rise to the appellations of coulter-nebs and parrot-bills, vulgarly applied to them. At the base of the bill there is generally an elevated fold of bare skin; and the nostrils, which are close to the margin, are mere slits. The puffins fly with rapidity, in a direct line, at the height of only a few feet over the waves; swim and dive with extreme dexterity; and nestle in the crevices of rocks, or more generally in holes formed by themselves in the turf.

The species best known and most extensively distributed is the common puffin, *Fratercula arctica*, which is of the size of a pigeon or jackdaw, with the upper parts dusky, the lower white, a broad black band round the neck, the bill red, with three grooves across each mandible. It is abundant on the northern coasts of Europe and America, where it breeds in burrows formed by itself in the soil of unfrequented islands and headlands, making no proper nest, and laying a single whitish and pyriform egg.

Another species, having a still more singular appearance, on account of two tufts of silky feathers on its head, inhabits the shores of Kamtschatka, the Kurile Isles, and others lying between Asia and America. The skins are employed by the natives as an article of clothing.

Some species having the bill less elevated, somewhat quadrangular, and notched near the tip, have been distinguished by M. Temminck under the generic name of Phaleris. Of these may be mentioned the *Ph. psittacula*, and *Ph. cristatella*, both inhabitants of the north-western coast of America, Kamtschatka, and the Kurile Isles.

The auks properly so called, or restricted genus Alca, have the bill more elongated, and in shape somewhat resembling the blade of a common pocket-knife, its base being feathered as far as the nostrils. As an example of the errors into which persons little conversant with living birds may fall, may be adduced the following statement of Cuvier with regard to the auks: "Their wings are decidedly too small to sustain them, and they do not fly at all." So far is this from being the case with our common species, that it flies with as much celerity as the guillemot and puffin, and in its ordinary flight outstrips the gulls and terns, although these birds fly with greater buoyancy. The statement, however, is correct as applying to the great auk, which might perhaps with propriety be referred to a separate genus.

The species so common on our coasts, as well as on those of Europe and North America, is the razor-billed auk, *Alca torda*, which is about the size of the common guillemot, and similarly coloured, being black above and white beneath, with a white band on the wing, and a line or two of the same colour on the bill.

The great auk, *Alca impennis*, is the largest bird of this family, equalling a goose in size. Its colour is similar to that of the common species; but its bill, which is marked with eight or ten grooves, is entirely black, and it has an oval white spot between the bill and the eye. Its wings are reduced to a kind of paddles, and are similar to those of the penguins, so that it does not possess the faculty of flying. It inhabits the highest latitudes of the globe, but is extremely rare, so that specimens are of very unfrequent occurrence in collections, and the only one in this country is that of the British Museum. A few instances have occurred of its being seen on the northern coasts of Scotland. In the northern seas this remarkable bird seems to represent the species of the next group, which belong to the other extremity of the globe.

3*d*. The penguins,—*Aptenodidæ*, are entirely destitute of the faculty of flying, their wings being converted into small, oblong, flattened paddles or fins, covered with minute scale-like feathers. Their body is elliptical and depressed, their neck of moderate length, their head oblong, their bill of moderate length, generally slender and pointed, the upper mandible covered with feathers for a third of its length, or as far as the nostrils, whence a groove extends to the tip. Their legs are very short, and placed so far behind that they cannot support themselves on land, even in a vertical position, without resting on their tarsi, which are flattened behind, somewhat like the foot of a quadruped. Their life is chiefly spent on the ocean, and as they possess the faculties of swimming and diving in the highest degree of perfection, they are the most truly aquatic of all birds, and the analogues of the swallows, which are the most aërial. If any bird approaches nearly in structure and habits to a quadruped, the penguins may claim kindred with the seals, which they greatly resemble in their mode of life, going on shore merely to breed, and dragging themselves over the rocks in a similar manner.

The penguins peculiarly so named, genus Aptenodytes, as restricted, have the bill rather long, slender, and pointed, the upper mandible slightly arched towards the end, and covered with feathers at the base; the nostrils linear, with the nasal groove extending to the tip.

The Patagonian or great penguin, *Aptenodytes Patagonica* (Plate CCCCI. fig. 4), is nearly of the size of the great auk, of a dark-grayish blue above, white beneath, the head black, and a yellow curved band on the fore neck. It occurs in great flocks on the coasts of the Falkland Isles, New Guinea, New George, the Straits of Magellan, and other antarctic lands; feeds on fish, crustacea, and mollusca; and is employed by the natives as an article of food, although its flesh is dark-coloured and rank.

The gorfous, genus Chrysocoma, have the bill short, strong, and somewhat conical, with the point a little arched. (Plate CCCCI. fig. 3 *b.*) The groove from the nostril ends about a third from the tip. In other respects they do not differ materially from the penguins.

The leaping gorfou, *Chrysocoma saltator*, is a handsome bird, of the size of a domestic duck, with the head and upper parts grayish black, the lower white, and the head ornamented with a large crest, of which the central part is erect and dusky, the lateral portions deflected, and of a yellow colour. It is common in the Falkland Islands and other parts of the southern seas; and, like the Patagonian penguin and other birds of this group, is said to be so stupid as to allow itself to be assailed without attempting to escape. It is extremely expert at diving; and like several birds of different families, such as the cormorants and darters, is often observed, while about to plunge beneath the surface, to leap several feet out of the water,—whence our sailors have named it the hopping penguin, or jumping Jack. The word gorfou is a corruption of goir-fugel, or gare-fowl, applied in Ferroe and the north of Scotland to the great auk, *Alca impennis.*

Several other species of this genus are known, and inhabit the same seas, such as the Papuan gorfou, *Chr. Papua;* the collared, *Chr. torquata;* the red-footed, *Chr. catarractes;* and the little gorfou, *Chr. minor.*

The sphenisques, genus Spheniscus, form a group characterized by their straight, compressed bill, which is irregularly grooved at the base, and has the tip of the upper mandible curved, while that of the lower is obliquely truncate, as in the cormorant. (Plate CCCCI. fig. 3 *a.*)

The Cape sphenisque, *Spheniscus demersus*, is about twenty inches long, black above, white beneath, with the throat and cheeks black, a white line over each eye, and a black band across the fore part of the neck, and extending along each side of the body. It occurs in the vicinity of the Cape of Good Hope, where it nestles in the rocks.

Another species, *Spheniscus Magellanicus*, upwards of two feet long, with the upper parts, a band on the breast, and a collar on the middle of the neck, black, inhabits Terra del Fuego, the Straits of Magellan, and other parts of the antarctic regions, where they are very numerous. This species, like the gorfou, and probably all the birds of this tribe, has a habit of leaping several feet out of the water, either when about to dive, or when it meets with any obstacle on the surface.

FAMILY II.—LONGIPENNÆ.

To this family belong those wandering sea-birds which, having a flight characterized by extreme buoyancy and rapidity combined, are met with on all parts of the ocean, frequently at the greatest distance from land. Their wings are always very long, although often extremely narrow; and their tail is proportionally developed. Their hind toe is small and free, or wanting; their bill pointed or hooked at the tip, but without lamellæ; their inferior larynx has only one muscle on each side; their œsophagus is wide, their stomach muscular, their cæca short. They are incapable of diving and pursuing their prey under the surface, but they swim with ease, and sit lightly and gracefully on the water. Some of them obtain their food by dipping or plunging from on wing, others by picking it up as they swim, while several wander to great distances in quest of dead animals of all kinds, and are in fact the vultures of the sea.

The petrels, *Procellariæ*, have their bill hooked at the tip, which seems as if formed of a separate piece articulated to the rest (Plate CCCCI. figs. 5, 6, and 9); their nostrils placed close together, and enclosed by a tube which lies on the back of the upper mandible; and their hind toe reduced to a knob with a claw upon it. These birds, although many of them are very small, reside on the open ocean, where they are met with by voyagers in the most tempestuous as in the calmest weather. Their food consists of small fishes, crustacea, and especially oily substances of all kinds; and most of them when seized, whether on being wounded or on being dragged from their holes, disgorge an oleaginous matter, or squirt it through their nostrils. They are incapable of diving, and seldom swim, but are generally seen flying or gliding over the surface of the waves, mounting upon their ridges and descending into the hollows, often so close as to seem walking on the water. Hence the name Petrel, or Little Peter, bestowed upon them, in allusion to St Peter's progress on the waves. In stormy weather they frequently fly in the wake of a ship, to shelter themselves from the wind. On account of this habit they are held in aversion by sailors, who, imagining them to be predictive of tempests, and in league with the mysterious source of evil, bestow on them the opprobrious appellation of Mother Carey's chickens. Their flight is rapid and buoyant; they breed in holes and crevices of the rocky coasts; and are more numerous in the antarctic than in the northern seas.

Those which have the lower mandible truncate are more peculiarly named petrels, genus Procellaria.

Of these the largest is the giant petrel, *Procellaria gigantea*, which has a length of about three feet and a half, and is of a dusky colour above, whitish beneath, with the bill and legs yellow. It is of frequent occurrence in the southern seas, is observed to be most lively in stormy weather, and feeds on fishes, and the carcasses of seals, birds, and other animals.

The pintado, or Cape petrel, *Procellaria Capensis*, is about fourteen inches long, variegated with brown and white, and occurs in large flocks in the antarctic seas, particularly in the vicinity of the Cape of Good Hope. Like most of the other species, it flies very low, feeds on fish

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and the carcasses of cetaceous animals, and when caught squirts out a quantity of oil from the nostrils.

In the arctic seas a very abundant species is the fulmar petrel, *Procellaria glacialis*, which is nearly of the size of the herring gull, and has the upper parts of a light bluish-gray, the head and lower parts white. It is extremely voracious, and although its principal food consists of fish, it devours indiscriminately any floating animal substance, and follows in flocks the track of a wounded whale, until the huge animal is exhausted, when it alights on the carcass, and devours the blubber until satiated. This bird is one of those most familiar to the sailors of the whale-ships, on which it constantly attends, to pick up any offal that is thrown overboard, and come in for its share of the plunder when a whale has been captured. It breeds abundantly in the island of St Kilda, the inhabitants of which obtain a large quantity of oil from the stomachs of the individuals which they catch for that purpose.

Of the smaller dark-coloured species may be mentioned the common or storm petrel, *P. pelagica*, which is not larger than a lark, and in its flight resembles a swallow (Plate CCCCI. fig. 5); Leach's petrel, *P. Leachii;* and Wilson's petrel, *P. Wilsonii*. Respecting the latter, we may quote the following passage from the description given of it by M. Audubon, in his *Ornithological Biography*. "But now, ever flapping its winglets, I have marked the little bird, dusky all over save a single spot, the whiteness of which contrasts with the dark hue of the waters, and the deep tone of the clear sky. Full of life and joy, it moves to and fro, advances towards the ship, then shoots far away, gambols over the swelling waves, dives into their hollows, and twitters with delight as it perceives an object that will alleviate its hunger. Never fatigued, the tiny petrels seldom alight, although at times their frail legs and feet seem to touch the crest of the foaming wave. I love to give every creature all the pleasure I can confer upon it, and towards the little things I cast over the stern such objects as I know they will most prize. Social creatures! would that all were as innocent as you! There are no bickerings, no jealousies, among you; the first that comes is first served: it is all the result of chance; and thus you pass your lives. But the clouds gather, the gale approaches, and our gallant bark is trimmed. Darkness spreads over the heavens, and the deep waters send back a blacker gloom, broken at intervals by the glimmer of the spray. You meet the blast, and your little wings bear you up against it for a while; but you cannot encounter the full force of the tempest; and now you have all come close beneath me, where you glide over the curling eddies caused by the motion of the rudder. You shall have all possible attention paid you, and I will crawl to the camboose, in search of food to support your tiny frames in this hour of need. But at length night closes around, and I bid you farewell....The gale is over; the clear blue of the sky looks clearer than ever, the sun's rays are brighter, on the quiet waters the ship seems to settle in repose, and her wings, though widely spread, no longer swell with the breeze. At a distance around us the dusky wanderers are enjoying the bright morning; the rudder-fish, yesterday so lively, has ended its career, so violently was it beaten by the waves against the vessel; and now the petrels gather around it, as it floats on the surface. Various other matter they find; here a small crab, there the fragments of a sea-plant. Low over the deep they range, and now with little steps run on the waters. Few are their notes, but great their pleasure, at this moment. It is needless for me to feed them now, and therefore I will return to my task."

The puffin-petrels, genus PUFFINUS, are separated from the rest on account of their having the extremity of the lower mandible decurved as well as that of the upper, and the nostrils opening, not by a common orifice, but by two distinct apertures. (Plate CCCCI. fig. 9.)

Of this genus may be mentioned the cinereous puffin-petrel, *Puffinus cinereus;* the Manks petrel, *Pr. anglorum;* and the dusky petrel, *Pr. obscura*.

In the genus HALADROMA of Illiger, the throat is dilatable like that of the cormorants, and the hind toe is entirely wanting as in the albatrosses. In the genus PACHYPTILA of the same author, the bill is enlarged at the base, and its margins are garnished interiorly with fine delicately-pointed vertical lamellæ. (See Plate CCCCI. fig. 6.)

The albatrosses, genus DIOMEDEA, are the largest and most powerful of all the feathered wanderers of the ocean. Their bill, which is large, strong, and sharp-edged, is terminated by a strong hook; their nostrils, which are tubular, are placed apart; and their feet are destitute of the hind toe. Their plumage is full, soft, and elastic, and their wings, although narrow, are exceedingly long. They are thus equally organized for swimming and flying, and are met with in all parts of the intra-tropical and southern oceans, sometimes following a ship in full sail for many days, to pick up the refuse thrown overboard. They fly with surprising buoyancy and speed, and are able to bear up against the most violent tempests. When fatigued or satiated they rest upon the waters. Their food consists of the carcasses of all sorts of animals, as well as live fishes, crustacea, mollusca, and other creatures, and their voracity is such that sometimes having gorged themselves to excess, they are unable for a time to fly, and may be caught or destroyed. Under these circumstances, however, birds generally disgorge the contents of their gullet and stomach, and by thus lightening themselves, are enabled to escape.

Of the different species of this genus, that which is the best known, as well as the largest, is the wandering albatross, *Diomedea exulans*. It is as large as a swan, being four feet in length, and measuring ten feet between the tips of its extended wings; its upper parts dusky, the lower white, the neck and sides transversely streaked with brown, the primary quills black, the bill yellowish white, the feet flesh-colour. This celebrated bird is principally met with in the seas adjacent to the Cape of Good Hope, and in those that separate the American continent from the Asiatic. It is extremely voracious, feeding on fishes, mollusca, and the carcasses of whales and other animals. It is said that when it cannot swallow a large fish at once, it introduces part of it, and waits until it is digested before swallowing the rest. Its flesh, although hard and dry, is eaten by the inhabitants of Kamtschatka, who use its bones for tobacco-pipes and needle-cases.

From the albatrosses to the larger birds of the next genus the transition is but slight, both as regards form and habits.

The gulls, genus LARUS, Plate CCCCI. fig. 8, constitute an extensive group, of which representatives are found in all parts of the globe. They are characterized by their longish, compressed bill, of which the upper mandible is arched towards the end, while the lower is there furnished with an angular prominence. The nostrils, which are placed near the middle, are linear-oblong and pervious. Their body is generally light, the neck of moderate length, their head ovate and rather large, their legs of ordinary length, and their hind toe very small, or sometimes obsolete. Some of the species are met with in the open ocean, but it is chiefly along the coasts, and especially near the mouths of rivers, that they are most frequently seen, and in stormy weather they often make incursions over the land in search of worms, larvæ, and carrion. Their food consists chiefly of small fishes, crustacea, and mollusca; but to the larger species hardly any animal substance comes amiss. They breed along the shores, on unfrequented islands and headlands, laying in a hollow on the ground from two to four eggs, spotted with dusky.

Among the larger species, some are remarkable for the dark or blackish hue of their back and wings; but in general the colour of those parts is a light-grayish blue, while that of the lower is pure white. One species, the ivory gull, *Larus eburneus*, has the plumage entirely of the latter colour when in the adult state. The greater black-backed gull, *Larus marinus*, the smaller black-backed gull, *Larus fuscus*, and the thick-billed gull of New Holland, *Larus melanoleucos*, afford examples of the first kind above alluded to. The largest known species is the burgomaster, *Larus glaucus*, of a light-grayish blue above, white beneath, with the tail and tips of the wings also white. It inhabits the arctic regions of Europe and America, seldom making its appearance in the temperate climates. One of the most common species on our coasts is the herring gull, *Larus argentatus*, which remains with us throughout the year. A gradual transition is observable from these larger species, which assimilate to the albatrosses, to the smaller, which are intimately connected with the terns.

Some species having very peculiar characters, have been separated from the gulls, and formed into a genus apart. These are the jagers, genus Lestris, which have the tip of the upper mandible hooked, and the nostrils larger and placed nearer the end of the bill than those of the gulls. Their tail is generally pointed, their wings long, and their flight is extremely rapid. Although they occasionally fish for themselves, they obtain their food chiefly by attacking various species of gulls and terns, which they teaze to make them disgorge their food, which they then swallow.

Of this genus the more remarkable species are the skua, *Lestris catarractes*, which is nearly equal in size to the great black-backed gull; the pomarine jager, *L. pomarinus*; and Richardson's jager, *L. Richardsonii*, which is common on our coasts in autumn, and breeds in the Shetland Islands and Hebrides.

The terns, genus Sterna, are generally of small size, and remarkable for their slender body, long and narrow wings, and forked tail. Their feet are extremely short, and their bill longish, compressed, and pointed. They very seldom swim, but, when fatigued or satiated with food, repose on the rocks or sands. Their flight is extremely buoyant, and they usually obtain their food by plunging after it into the water from on wing. From their form and the peculiar mode of flying, they have also obtained the name of sea-swallows.

The most common species on the coasts of Europe are the arctic tern, *Sterna arctica*; the common tern, *St. Hirundo*; and the little tern, *St. minuta*; but several other species occur there.

The noddies, genus Anous, differ from the terns in having the tail even at the end, and nearly equal with the wings. Their bill also is more like that of the smaller gulls. They are said to be so stupid as to allow themselves to be killed without attempting to fly off; but this only happens in places where they have not been accustomed to meet with man.

The species best known is the black noddy, *Anous niger* (*Sterna stolida*, Linn.), which is very common in the tropical seas, and is of a sooty-brown, excepting the top of the head, which is grayish white. It often settles on the rigging of vessels, when the sailors sometimes catch it at night while asleep.

The skimmers, genus Rhynchops, Plate CCCCI. fig. 7, are very nearly allied to the terns, but are distinguished from all other birds by the extraordinary form of their bill, of which the upper mandible is considerably shorter than the lower, and grooved beneath, so as to receive the edge of the latter, which is extremely thin. They procure their food in the same manner as the terns, skimming along the surface of the water, and dipping their bill into it to seize a small fish, as opportunity occurs.

The only species whose habits are known is the black skimmer, *Rhynchops nigra*, which is about twenty inches long, its bill and feet red, its upper parts black, the lower white, its wings considerably longer than the tail. It occurs along the coasts of America, from New York to Brazil, breeding on the sandy shores in June, and continuing in flocks all the year.

FAMILY III.—TOTIPALMÆ.

The birds of which this family is composed are those to which the epithet *palmipede* is more peculiarly applicable; for not only are their anterior toes connected by webs or membranes, as in the other tribes, but their hind toe is similarly connected with the inner. Their tarsi are generally short, their wings and tail long, their neck elongated, and their bill rather slender, somewhat conical, but generally hooked at the joint. They swim, and for the most part dive, with admirable dexterity, generally fly with great celerity, feed entirely on fishes and other marine animals, and are remarkable among web-footed birds for frequently perching on trees.

The pelicans, *Pelecani*, comprehend those which have at the base of the bill a space destitute of feathers. The skin of their throat is extensile, their tongue very small, their gullet of great width, their cæca small, their nostrils mere slits, sometimes obsolete.

The pelicans properly so called, genus Pelecanus, Plate CCCCI. fig. 10, are distinguished from all other birds by the singular structure of their bill, of which the upper mandible, however, presents nothing very remarkable, while the lower has its rami extremely slender and elastic, with a large dilatable membranous bag attached to it. They are birds of large size, with wings of moderate length, the tail rounded, the feet short, and the claws curved.

The most remarkable species is the common pelican, *Pelecanus onocrotalus* (above referred to), which is as large as a swan, and entirely of a white colour tinged with red, excepting the alula and primary quills, which are black. Its length is nearly six feet, and its extended wings measure about fifteen. Its upper mandible is flattened, with a hook at the point; and the sac appended to the lower mandible extends about nine inches down the neck, and may be dilated so as to hold a man's head with ease. This pelican occurs in the tropical and warmer temperate regions of the old continent, and is common in the eastern countries of Europe. Its principal food is fish, which it catches with great dexterity, by plunging after it from on wing. In fishing it fills the gular pouch, and does not immediately devour its prey, but when it has obtained a sufficiency, returns to the shore, and swallows it at leisure. The female forms a large nest of grass in a marshy place, and lays two or three white eggs, similar to those of a swan.

The brown pelican, *P. fuscus*, of a grayish-brown colour, and nearly four feet in length, is common in most parts of America, and especially in the West Indies. A very large species, *P. australis*, of a white colour, with the upper part of the back, the quills, and tail, black, inhabits New Holland.

The cormorants, genus Phalacrocorax, resemble the pelicans in their general form, but are destitute of the large gular sac, having merely a bare dilatable membrane at the base of the lower mandible. They differ farther in not procuring their prey by plunging after it from on wing, their mode of fishing being similar to that of the divers.

The common cormorant, *Phalacrocorax carbo*, is nearly as large as a goose, and has a brownish-black colour, with a white spot on the thigh, and streaks of the same colour on the head and neck. It nestles in the cavities of rocks, or on trees, laying three pale-green eggs, crusted with white calcareous matter; and is common in the northern parts of both continents. It is stated that this species was formerly trained in England for the purpose of catching fish. "When they come to the rivers," says Willughby, "they take off their hoods, and having tied a leather thong round the lower part of their necks, that they may not swallow down the fish they catch, they throw them into the river. They presently dive under water, and there for a time, with wonderful swiftness, they pursue the fish, and when they have caught them, they rise presently to the top of the water, and pressing the fish lightly with their bills, they swallow them, till each bird hath in this manner swallowed five or six fishes; then their keepers call them to the fist, to which they readily fly, and, little by little, one after another, vomit up all their fish, a little bruised with the nip they gave them in their bills. When they have done fishing, getting the birds on some high place, they loose the string from their neck, leaving the passage to the stomach free and open; and for their reward they throw them part of the prey they have caught, to each, perchance, one or two fishes, which they by the way, as they are falling in the air, will catch most dexterously in their mouths."

A very common species on our coasts is the crested cormorant, *Phal. cristatus*, which is of a dark-greenish colour, with a recurved frontal tuft, and resembles the preceding in its habits, breeding in the rocky caverns of islands and headlands. Many other species occur in different parts of the world, the genus being generally distributed.

The frigate-birds, genus Tachypetes, differ from the cormorants in having the tail forked, the wings extremely elongated, the feet very short, with their webs emarginate, and the tip of both mandibles decurved. Their flight is extremely rapid and buoyant, and they prey upon fishes, which they capture by plunging after them from on wing, or obtain by forcing the gannets to disgorge. Only one species is well known.

The common frigate-bird, *Tachypetes aquilus*, is of a dusky colour, more or less variegated with white on the neck, and sometimes measures ten feet between the tips of its extended wings. It inhabits the tropical regions, and is found in great abundance on the island of Ascension. Its principal food consists of flying-fishes, which it captures during their aërial excursions. The following account of this remarkable species, generally known to navigators by the name of the man-of-war, or frigate, is given by Mr Audubon. "This bird is possessed of a power of flight, which I conceive superior to that of perhaps any other bird. However swiftly the Cayenne tern, the smaller gulls, or the jager, move on wing, it seems a matter of mere sport to it to overtake any of them. The goshawk, the peregrine, and the gyr-falcon, which I conceive to be the swiftest of our hawks, are obliged to pursue their victim, should it be a green-winged teal or passenger-pigeon, at times for half a mile, at the highest pitch of their speed, before they can secure them. The bird of which I speak comes from on high with the velocity of a meteor, and on nearing the object of its pursuit, which its keen eye has spied while fishing at a distance, darts on either side to cut off all retreat, and with open bill forces it to drop or disgorge the fish which it had just caught. See him now! yonder, over the waves leaps the brilliant dolphin, as he pursues the flying-fishes, which he expects to seize the moment they drop into the water. The frigate-bird, who has marked them, closes his wings, dives towards them, and now ascending, holds one of the tiny things across its bill. Already fifty yards above the sea, he spies a porpoise in full chase, launches towards the spot, and in passing seizes the mullet that has escaped from its dreaded foe; but now, having obtained a fish too large for his gullet, he rises, munching it all the while, as if bound for the skies. Three or four of his own tribe have watched him, and observed his success. They shoot towards him on broadly extended pinions, rise in wide circles, smoothly, yet as swiftly as himself. They are now all at the same height, and each, as it overtakes him, lashes him with its wings, and tugs at his prey. See! one has fairly robbed him, but before he can secure the contested fish it drops. One of the other birds has caught it, but he is pursued by all. From bill to bill, and through the air, rapidly falls the fish, until it drops on the waters, and sinks into the deep. Whatever disappointment the hungry birds feel, they seem to deserve it all."[1]

The boobies, or gannets, genus Sula, have the bill straight, conical, a little compressed, and with the point somewhat deflected, the edges serrate, or cut into by short parallel lines. The throat and the space around the eyes are bare; the claw of the middle toe serrate, the wings long and very narrow, and the tail cuneate or tapering. They hover over the water when fishing, and plunge headlong after their prey, resting a few moments on emerging before they resume their flight.

The common gannet or solan goose, *Sula bassana*, occurs on the coasts of Europe and North America, and breeds in vast numbers on remote and rocky islands. The Bass Rock at the entrance of the Frith of Forth is a well-known haunt of this species, as are Ailsa Craig in the Clyde, St Kilda, and Suliskerry. The nest is very bulky, and composed of sea-weeds; the single egg not larger than that of a domestic duck, and of a white colour; the young, at first covered with snow-white down, is when fledged of a dark-brown colour, spotted with white. Although the flesh of this species is rank and oily, it was formerly considered a kind of delicacy, and is still sparingly used in the south of Scotland.

The booby gannet, *Sula candida*, is inferior in size to the species just mentioned, which it closely resembles in form and habits. It is common on the coasts of the warmer parts of America, particularly in the Bahama Islands and the Brazilian seas. Although it sometimes nestles on the ground, it generally builds on trees, and reposes there at night. It is said to be a very stupid bird, allowing itself to be knocked on the head or seized, without attempting to escape,—whence the name of booby, commonly given to it by the sailors, who frequently employ it as an article of food, although its flesh is dark-coloured and disagreeable.

The darters, genus Plotus, resemble the cormorants in the form of their body and feet, but are more slender, and have a very elongated neck, with a small head, and a straight, slender, and pointed bill. Like the cormorants, they swim deep in the water, but with agility, and in diving spring fairly out of it to plunge headlong after their prey. They inhabit the warm countries of America.

The black-bellied darter, *Plotus melanogaster*, Plate CCCCII. fig. 1, is upwards of three feet long, of a dusky colour, with the neck and back streaked with white. The white-bellied darter, *P. anhinga*, is about the same size, but has the lower parts white. It inhabits Brazil and

[1] *Ornithological Biography.*

other parts of America, roosting at night on trees, whence, should one approach, they drop into the water as if dead; and on emerging at a distance, show only their long slender necks and heads, which bear so much resemblance to those of serpents, that this species is frequently named the snake-bird.

The tropic birds, genus PHAETON, which form the last group of this section, bear a considerable resemblance to the gannets, but are readily distinguished by the two extremely elongated feathers of their tail, on account of which the French give them the not inappropriate name of *paille-en-queue.* Their head is entirely feathered; their bill straightish, tapering, pointed, and denticulated on the edges; their feet are short, and their wings long. The flight of these birds is rapid and buoyant, and they are often seen far out at sea. As they seldom extend their range beyond the tropics, their occurrence apprises navigators of their entrance into the warmer regions. They perch and nestle upon trees.

Two species are distinguished;—the common, or white-tailed tropic bird, *Phaeton æthereus;* and the red-tailed species, *Ph. phœnicurus.* The former is white, with the ocular region and shoulders black, the primary quills of the same colour, and the bill red. It inhabits the Atlantic Ocean. The latter is of a pale rose-colour, or reddish white, with the ocular region and wing-coverts deep black, and the two elongated feathers of the tail red. It occurs in the Indian and African Seas, at Madagascar, the Cape of Good Hope, the Isle of France, and many of the South Sea islands.

FAMILY IV.—LAMELLIROSTRES.

The birds of this family are readily distinguished from those of the preceding by the peculiar structure of the bill, which has its margins furnished with horny lamellæ, or dentiform processes, and its surface covered with soft skin, in place of the horny envelope which is spread over that of the other Palmipedes. The tongue, which is broad and fleshy, has its margins also lamellate; the gizzard is extremely muscular, although not of large capacity, and the cæca are rather long. Another remarkable distinction is found in the lower larynx, which generally has a very extraordinary dilatation in the males. Their body is usually somewhat depressed, their wings of moderate length, their feet short, and their neck more or less elongated, sometimes of extreme length. They swim with ease, but walk in a constrained and vacillating manner; and are for the most part phytophagous, though many feed on mollusca, crustacea, and fishes. They occur in all parts of the globe,—some being maritime, but the greater number lacustrine or fluviatile, that is, frequenting lakes or rivers. They are naturally arranged into two groups;—the one (*Anatidæ*) comprising the swans, geese, and ducks; the other (*Mergidæ*) composed of the mergansers.

The great group of *Anatidæ* includes all those web-footed birds which have their bill large and broad, covered with a thin membrane, and having its edges furnished with transverse or oblique lamellæ, the object of which seems to be to allow the water to escape when the bird has seized its food. Vegetable substances, especially seeds, roots, and blades of grasses, form the principal nourishment of many of the species; but others feed on fishes, mollusca, insects, and worms. The piscivorous species dive in pursuit of their prey, while those which feed on vegetable matter either procure it on shore, or along the margins of the water, or, while floating on the surface, obtain it from some depth by means of their long neck. The flesh of many of these birds is much esteemed, but is not so readily digestible as that of the waders and gallinaceous order. Many of them moult twice in the year, and after the summer change the males assume in part the colours peculiar to the females, which, on the contrary, exhibit no variation. They generally breed in marshy places, and deposit numerous eggs. The young, which are at first covered with stiffish down, are capable of walking and swimming immediately after birth.

The characters by which the subdivisions of this group are distinguished are derived chiefly from the form of the bill. In the swan that organ is as broad at its fore part as at the base, where its height is greater than its breadth, and the nostrils are placed about the middle. In the geese, the bill is shorter than the head, higher than broad at the base, and narrower towards the end. Lastly, in the ducks properly so called, the bill is at least as broad at its extremity as at the base, where it is broader than high; the nostrils are placed on the back of the bill near the base. In the swans the neck is extremely long, in the geese of moderate length, and in the ducks generally rather short.

The *swans*, genus CYGNUS, are the largest birds of the family, and are characterized by the elegance of their form, and the graceful ease with which they glide over the surface of the water, although on land their motions are more constrained. Their body is large, their neck extremely elongated, their head oblong, their wings large, and their feet short and strong. They live chiefly on the seeds and roots of aquatic plants, and nestle among the reeds by the margins of lakes and rivers. They are strictly monogamous, and the young swim and walk immediately after exclusion.

The wild swan, *Cygnus ferus*, has the bill yellow at the base, and black towards the end, the plumage pure white, but in the young of a gray colour. It is readily distinguished from the domestic swan by having the base of the bill flattened above, and by the curvature formed by the wind-pipe, which enters into a cavity in the crest of the sternum, from which it is reflected anteriorly, and then passes into the thorax. This species inhabits the northern regions of both continents, whence it migrates southward on the approach of winter, remaining in the temperate countries until the return of spring. The female lays from five to seven or eight eggs, of a whitish colour tinged with olive, and is said to incubate six weeks. The flesh and eggs are highly esteemed, and the skins are prepared with the down to be made into garments. The down itself forms an article of commerce, which is in considerable demand in the colder countries of Europe. The song of the swan is familiar to all the lovers of poetry; but, like many equally accredited facts, has no real existence; for the cry of this bird, although clear and shrill, is never modulated into harmony. When heard at a distance, however, especially from a flock on wing, it is extremely pleasing. Another fable regarding the vast strength of wing of this bird was long believed,—a blow from it being alleged as sufficient to break a man's thigh. "It is high time," says Montagu, "such absurdities should be erased in this philosophic age, and that the mind of man should reason before he continues to relate such accounts, only calculated to frighten children. Let the bones of the wing of the swan be examined, and compared with the thigh of a man, or even of his arm, and it will be evident that it would be as impossible for a swan to break a man's arm, as it would be to break his head with a reed. The bone of a man's arm would bear a pressure fifty times as great as the bone of a swan's wing; how, then, is the inferior in size and strength to break the superior, without at least being itself fractured? It should also be recollected, that a bird is incapable of striking with any degree of force while all its quill-feathers are perfect, the resistance of the air against such a surface being too great to allow of

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its moving with sufficient velocity to inflict any sensible pain."[1]

A species very nearly allied to the above is Bewick's swan, *Cygnus Bewickii*, which was first distinguished as a species by Mr Yarrell and Mr Richard Wingate of Newcastle. It has the bill black, with its base orange yellow, the plumage white, and the tail of eighteen feathers, whereas there are twenty in that of the common wild swan. The curvature of the trachea is also different, and the size of the species is about a third smaller. It inhabits the arctic regions of both continents, migrating southward in winter.

The mute or tame swan, *Cygnus olor*, has the bill red, its edges, the nail at its tip, and a large knob at the base of the upper mandible, black; the plumage white, the tail of twenty-four feathers. In this species the trachea has no extra thoracic curvature. The tame swan is said to be found in its wild state in the eastern countries of Europe and Asia. It is generally distributed over Europe in a domesticated state, forming a great ornament to our rivers and artificial pieces of water. It makes its nest of grass, among reeds, and deposits seven or eight eggs of a greenish-white colour, which are hatched in seven or eight weeks. The young are of a gray colour, and were formerly much esteemed as an article of food.

The black swan, *Cygnus atratus*, of which the general colour of the plumage is brownish black, with part of the wings white, and the bill red, inhabits various parts of New Holland, and is now not uncommon in a domesticated state in this country. (See Plate CCCCII. fig. 5.)

Intermediate between the swans and geese are several species, such as the Guinea goose, *Anas cygnoides* of Linnæus, and the spur-winged or Gambia goose, *Anas Gambensis* of the same author,—which, although less elegant than the swans, are yet nearly allied to them in the form of their bill.

The *geese*, genus Anser, are distinguished, as has been already said, by the form of their bill, which is short, and narrowed towards the point. Their feet are also proportionally longer than those of the ducks, so that they have a greater facility in walking. They swim less, however, and are incapable of diving. They live in flocks, feed on gramineous plants and seeds, migrate in large bodies, which during their flight are usually disposed in divergent lines, and breed in marshy places, laying numerous eggs. Those species which have the bill more slender and somewhat cylindrical, are separated by some authors to form the genus Bernicla. Three species of geese properly so called, and two of bernicles, are not uncommon during winter in this and other countries of Europe.

That to which the origin of the domestic goose is attributed, the gray lag, or common wild goose, *Anser ferus*, is nearly three feet long, with the bill large and of an orange colour, the feet flesh-coloured, and the plumage light gray and clove brown; the rump and lower parts white. It was formerly very abundant in this country, where it resided all the year, but is now met with only in small flocks in the winter season, although a few individuals have recently been found to breed in the north of Scotland—for example, in the islets of the lochs of Sutherland.

The bean goose, *Anser segetum*, is a little smaller, with the bill more elongated, and of an orange colour, with its base and the nail black; the upper part ash-gray tinged with brown, the rump dark brown, the abdomen and lower tail-coverts white. This species is much more plentiful with us than the last, appearing in large flocks in November, and retiring northward in April and May.

The white-fronted goose, *Anser albifrons*, has the bill and legs orange, the plumage gray on the upper parts, on the lower white, and a patch of the same colour on the forehead.

The common bernicle, *Anser leucopsis*, which has the forehead, cheeks, and throat white, with the crown of the head, the neck, and the breast black, is not unfrequent on the western coast of Britain in winter; and the brent goose, *Anser torquatus*, characterized by having the head, neck, and breast black, with a white patch on each side of the neck, is also common in many parts, especially along our eastern shores. The former of these species was long believed, even by the learned, to be the produce of a species of cirripodous animal, the *Lepas anatifera* of Linnæus, the long feather-like branchiæ of which gave rise to this absurd fable.

Another species of bernicle was observed, on Captain Parry's second voyage, on Melville Peninsula, and named by Dr Richardson, in the *Fauna Boreali-Americana*, in honour of Mr Hutchins, from whom Pennant and Latham derived most of their information respecting the birds of Hudson's Bay. It is about twenty-five inches in length, with a very short black bill; the head, neck, rump, and tail pitch-black, and a white kidney-shaped patch upon the throat.

From the bernicles and geese some authors distinguish, under the generic name of spurwing, Chenalopex, the species usually named the Egyptian goose, which has the bill longer than the bernicles, and has the wings armed with a spur upon the bend. It inhabits various parts of Africa, especially Egypt and the Cape of Good Hope, whence it has been introduced into this country.

The next genus, Cereopsis, is formed by a New Holland species, resembling the bernicles in form, but with the bill smaller, and having at its base a membrane extending over the forehead. The palmation of the feet is not so full as usual.[2] (Plate CCCCII. fig. 2.)

The *ducks*, properly so called, have the legs much shorter than the geese, and placed farther back, the neck shorter, and the body more depressed. Their trachea also has a large dilatation at its bifurcation.

Some of them, having the hind toe margined with a membrane or lobe, the tarsi more compressed, the head larger, and the wings shorter, feed on fishes and other aquatic animals, and are less expert at walking, but dive with greater agility. These species have been variously grouped by authors into numerous genera, of which the following are among the more remarkable.

The *scoters*, genus Oidemia, have the bill short and broad, with an elevated tumour or knob at the base, but towards the tip much depressed and flattened, the nail obtuse and roundish; the lamellæ widely set, and scarcely projecting; the nostrils oval and sub-medial, the tail short and graduated.

To this genus belong the velvet scoter, *Oidemia fusca;* the black scoter, *O. nigra;* and the surf scoter, *O. perspicillata;* which occur along the coasts of the northern temperate regions in winter, feeding on fishes, and especially mussels and other testaceous mollusca. Like that of the other sea-ducks, their flesh is held in little estimation, being dark-coloured and tough, with a fishy flavour.

The *garrots*, genus Clangula, have the bill shorter than the head, elevated at the base, narrowed towards the end; the lamellæ numerous, but not projecting; the nostrils roundish, and medial; the tail of moderate length, and graduated.

The golden-eye, *Clangula chrysophthalma*, which is white, with the head, the back, and the tail black, a small

[1] *Ornithological Dictionary.*

[2] For the history of the only known species, *Cer. Novæ Hollandiæ*, see *Zoological Gardens*, vol. ii. p. 315.

spot before the eye, and two bands on the wing, white, breeds in the arctic regions of both continents, and appears on the estuaries and lakes of the more temperate countries in winter. The female is of a gray colour, with the head brown.

To this genus belongs the harlequin-duck, *Clangula histrionica* (Plate CCCCII. fig. 3), which is distinguished by having a large patch of white on the lore, a spot on the ear, a longitudinal band on the sides of the neck, a transverse band on the neck, and another on each side of the breast, white; with the speculum or wing-spot blue, and the legs dusky. It derives its name from the singularity of its markings, and inhabits the northern parts of both continents.

The *pochards*, genus Fuligula, have the bill as long as the head, broad and much depressed anteriorly, and a little dilated towards the tip; the upper lamellæ not projecting beyond the margin; the nostrils oblong, sub-basal; the wings and tail short, the latter rounded. This section contains a great number of species, most of which are maritime and piscivorous, although the flesh of many is considered palatable, and that of one, the canvass-backed duck, has been celebrated by the epicures of the western world.

The red-headed pochard, *Fuligula ferina*, of which the head and neck are bright chesnut, the breast black, the sides and scapulars marked with undulated lines of black and grayish white, is not uncommon on the coasts of Europe during the winter, and is not unfrequently seen in our markets.

Another common species is the scaup-pochard, *Fuligula marila*, which has the head and neck black glossed with green, the back and scapulars whitish with undulating black lines, and the alar speculum white.

The canvass-backed pochard just alluded to, *Fuligula valisneria* (Plate CCCCII. fig. 4), resembles the red-headed species, and is characterized by having the forehead and cheeks dull brown; the head and upper part of the neck fulvous, the lower part with a black belt; the back, scapulars, and belly white, marked with narrow black lines. These birds arrive in the United States from the arctic regions about the middle of October, and frequent the large rivers and lakes, where they feed chiefly on the roots of a grass-like plant, the *Valisneria spiralis*. Although extremely shy, vast numbers of them are killed on account of the delicacy of their flesh. Towards evening they collect into large flocks, so extensive as sometimes to cover several acres, and, when rising simultaneously on wing, to produce a noise like thunder.

The *eiders*, genus Somateria, have the bill more elongated than that of the garrots, tumid and elevated at the base, and extending over the forehead in the form of two narrow processes; the lamellæ large and distant; the nostrils small, oval, and medial; the wings and tail short. The males are distinguished by their greater size and superior beauty. Only two species of this genus are known, both inhabiting the northern and temperate regions of Europe and America.

The common or St Cuthbert's eider, *Somateria mollissima*, is characterized by having the bill furnished at its base with lateral prolongations, in the form of two narrow flat lamellæ. The male has the lower parts black, the upper parts and the neck white, the top of the head violet-black, and the cheeks pale green. The female has the whole plumage reddish brown, with transverse black bars. This species is extremely abundant in Iceland, Lapland, Greenland, Spitzbergen, and the countries bordering on Hudson's and Baffin's Bays; but it is also common in all the northern parts of Europe and America. The female lays five or six pale greenish-gray eggs, and lines her nest, which is composed of sea-weeds and other maritime plants, with the fine and elastic gray down, which she plucks from her breast for that purpose. This down is carefully collected in northern countries,—each nest being generally robbed twice in the season. One female is stated to yield half a pound of down, which, however, is reduced to one half by being cleaned. It is extremely soft and warm, and so elastic that two handfuls are sufficient to fill a quilt five feet square. In 1750, the Iceland Company at Copenhagen sold so much of this article as produced 3747 rix-dollars, in addition to what was sent directly to Gluckstadt. Besides supplying this valuable down, the eiders afford an esteemed article of food to the Greenlanders, who moreover convert their skins into warm and comfortable under garments. Although the species occurs in Britain, it is nowhere so plentiful as to afford enough of down to render it available as an article of commerce.

The king-eider, *Somateria spectabilis*, which has the lateral prolongations at the base of the bill in the form of two elevated, compressed tubercles, is very similar to the other species, and inhabits the same countries, breeding in the same manner, and lining its nest with down of equal quality, plucked from its own plumage. The skins are formed into winter garments by the inhabitants of Siberia and Kamtschatka; but as this species is not so numerous as the other, its down is not of equal importance in a commercial point of view.

Other groups of ducks have the hind toe not bordered by any membrane, the head smaller, the feet narrower, the neck longer, the bill less tapering, and the body more slender. They feed chiefly on vegetable substances, although they also devour fishes, insects, worms, and mollusca. In this section, likewise, various generic divisions have been made.

The *shovellers*, genus Rhynchaspis, have the bill longer than the head, with the upper mandible semi-cylindrical, and enlarged at the end, and the lamellæ so long and slender as to resemble filaments.

The common shoveller, *Rhynchaspis clypeata*, inhabits various parts of the north of Europe and America, and is sometimes met with in England. It is about twenty inches in length, with the head and neck glossy-green, the back brown, the breast and abdomen brownish red, and the smaller wing-coverts pale blue.

Another species, the fasciated shoveller, *Rhynchaspis fasciata*, of a rusty-brown colour, transversely striped with white beneath, and having the tip of the bill membranaceous, is a native of New South Wales.

The *shielducks*, genus Tadorna, have the bill tumid and elevated at the base, where there is a small tubercle, but much flattened towards the point; the lamellæ short and distant; the nostrils oval and medial.

The common shieldrake, *Tadorna Bellonii*, which is one of the most beautiful species of this family, is not very uncommon in some parts of Britain, and occurs also on the coasts of the northern and western countries of Europe. It is characterized by having the head and upper part of the neck greenish black; the back, wing-coverts, and flanks white; the scapulars black, and a broad band on the breast ferruginous. The female nestles in a rabbit-burrow, or other hole in the sandy pastures on the sea-shore, generally forming her nest of down plucked from her breast, and laying from eight to twelve white eggs. Instances have occurred of its breeding with the common duck; and Montagu states that it bears confinement well, appearing to enjoy perfect health, provided access to a pond is allowed it.

The *musk-ducks*, genus Cairina, have the bill also furnished with an elevated tubercle at the base; the edges of the mandibles sinuated; the face and lores covered with a bare tuberculated skin; and the wings furnished with a knob or spur at the bend.

The common musk-duck, *Cairina moschata*, which is now generally distributed over Europe in a domesticated

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state, is a native of the warmer parts of America. In its natural state it has the plumage entirely of a black colour, glossed with green and blue, excepting the wing-coverts, which are white.

The *pintails*, genus DAFILA, have the bill destitute of tubercle at the base, narrow, somewhat cylindrical, with its edges dentato-laminate; the nostrils are basal, and the tail elongated, and tapering to a point.

The common pintail, *Dafila acuta*, has the head umber-brown, with a longitudinal white line on each side of the occiput and hind neck; the back and flanks undulated with black and grayish white; the lower parts white; and the two central tail-feathers black. It breeds in the arctic regions of Europe, Asia, and America; retires southward in winter; is very shy and vigilant; and is much esteemed as an article of food.

The ducks, strictly so called, genus ANAS, are distinguished by having the bill simple at the base, as long as the head, depressed, broad, and obtuse; the nostrils oval and small; the tail moderate, even, or rounded, often with the middle feathers and their coverts recurved.

Of this genus, the most common species in Europe is that which is supposed to be the original of the domestic duck, and which with us is named the wild duck or mallard, *Anas boschas*. The male is a very beautiful bird, having the head and upper part of the neck deep green, the latter with a white ring; the four middle tail-feathers recurved; the upper parts marked with fine undulated grayish-brown and white lines, the breast deep chesnut, the lower parts grayish white, undulated with grayish-brown lines; the alar spot green, edged above and below with white. It inhabits all the northern countries of the globe, and is common in Britain, where it breeds, forming its nest of withered plants in marshy places, and laying from ten to fifteen bluish-white eggs. Instances have occurred of its occupying the deserted nest of a crow. Its flesh is justly held in great estimation, and vast numbers are shot and caught in decoys. The following account of the method employed in capturing wild ducks in the fens of Lincolnshire is given by Bewick.

"In the lakes where they resort, the most favourite haunts of the fowl are observed: then in the most sequestered part of this haunt they cut a ditch about four yards across at the entrance, and about fifty or sixty yards in length, decreasing gradually in width from the entrance to the farther end, which is not more than two feet wide. It is of a semicircular form, but not bending much for the first ten yards. The banks of the lake, for about ten yards on each side of this ditch (or pipe, as it is called), are kept clear from reeds, coarse herbage, &c. in order that the fowl may get on them to sit and dress themselves. Across this ditch, poles on each side, close to the edge of the ditch, are driven into the ground, and the tops bent to each other, and tied fast. These poles at the entrance form an arch, from the top of which to the water is about ten feet. This arch is made to decrease in height as the ditch decreases in width, till the farther end is not more than eighteen inches in height. The poles are placed about six feet from each other, and connected together by poles laid lengthwise across the arch, and tied together. Over them a net with meshes sufficiently small to prevent the fowl getting through is thrown across, and made fast to a reed fence at the entrance, and nine or ten yards up the ditch, and afterwards strongly pegged to the ground. At the farther end of the pipe a tunnel-net, as it is called, is fixed, about four yards in length, of a round form, and kept open by a number of hoops about eighteen inches in diameter, placed at a small distance from each other to keep it distended. Supposing the circular bend of the pipe to be to the right, when you stand with your back to the lake, on the left-hand side, a number of reed-fences are constructed, called shootings, for the purpose of screening from sight the *decoy-man*, and in such a manner that the fowl in the decoy may not be alarmed when he is driving those in the pipe: these shootings are about four yards in length, and about six feet high, and are ten in number. From the end of the last shooting a person cannot see the lake, owing to the bend in the pipes: there is then no farther occasion for shelter. Were it not for these shootings, the fowl that remain about the mouth of the pipe would be alarmed, if the person driving the fowl already under the net should be exposed, and would become so shy as to forsake the place entirely. The first thing the decoy-man does when he approaches the pipe, is to take a piece of lighted turf or peat, and hold it near his mouth, to prevent the fowl smelling him. He is attended by a dog taught for the purpose of assisting him; he walks very silently about half-way up the shootings, where a small piece of wood is thrust through the reed fence, which makes an aperture just sufficient to see if any fowl are in; if not, he walks forward to see if any are about the mouth of the pipe. If there are, he stops and makes a motion to his dog, and gives him a piece of cheese or something to eat; upon receiving it, he goes directly to a hole in the reed-fence, and the fowl immediately fly off the bank into the water; the dog returns along the bank between the reed-fences and the pipe, and comes out to his master at another hole. The man now gives him another reward, and he repeats his round again, till the fowl are attracted by the motion of the dog, and follow him into the mouth of the pipe. This operation is called working them. The man now retreats farther back, working the dog at different holes till the fowl are directly under the net; he now commands his dog to lie down still behind the fence, and goes forward to the end of the pipe next the lake, where he takes off his hat, and gives it a wave between the shooting; all the fowl under the net can see him, but none that are in the lake can. The fowl that are in sight fly forward, and the man runs forward to the next shooting and waves his hat, and so on, driving them along till they come to the tunnel-net, where they creep in: when they are all in he gives the net a twist, so as to prevent their getting back; he then takes the net off from the end of the pipe with what fowl he may have caught, and takes them out one at a time, and dislocates their necks, and hangs the net on again, and all is ready for working again. In this manner five or six dozen have been taken at one drift. When the wind blows directly in or out of the pipes, the fowl seldom work well, especially when it blows in. If many pipes are made in the lake, they are so constructed as to suit different winds."[1] The better to entice the fowl into the pipe, hempseed is strewed occasionally in the water. The season allowed by act of parliament for catching these birds in this way is from the latter end of October till February.

The Chinese duck, *Anas galericulata*, with a pendent crest, and the inner wing-feathers enlarged and raised in a vertical direction, is an extremely beautiful species, a native of China and Japan.

The summer duck, *Anas sponsa*, which also has a pendent crest, is not less beautiful. (Plate CCCCII. fig. 8.) It inhabits Mexico and other parts of North America, migrating northward in summer, rarely visiting the seashore or salt marshes, but frequenting the muddy creeks, ponds, and mill-dams of the interior.

The tree duck, *Anas arborea*, of a gray colour, the ab-

[1] *British Birds*, vol. ii. p. 294.

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domen spotted with black and white, and the head slightly crested, inhabits the warmer parts of America, and is remarkable for building in the holes of decayed trees.

The gadwall or gray, *Anas strepera*, the Dominican duck, *A. Dominicana*, the Spanish duck, *A. viduata*, and many other species, belong to this genus,—which might include the teals, although these are separated by several authors.

The wigeons, genus Mareca, may be distinguished from the ducks, as they have the bill shorter than the head, higher than broad at the base, depressed and narrowed towards the end; the lamellæ slightly projecting; the tail short and acute. They are, however, very intimately allied to the pintails.

Of this genus one of the best examples is the common wigeon, *Mareca Penelope*, which has the forehead yellowish white, the rest of the head and the neck chesnut-red, the back and flanks undulated with black and white. The male of this species has been known to pair with the female pintail, and produce a hybrid brood. It also pairs with the common duck. Wigeons are abundant in winter in many parts of Britain, and are very much esteemed for the table.

The teals, genus Querquedula, are distinguished from the other groups by their diminutive size. Their bill is narrower than that of the wigeons, proportionally longer, and has its base more elevated. The species are generally very beautiful.

The gargancy teal, *Querquedula circia*, of a gray colour, variegated with black, and having a white streak above the eyes, with a green spot on the wing, inhabits the more temperate parts of Europe, and is abundant in Holland during its winter migration.

The common teal, *Querquedula crecca*, which has the head brownish red, the body transversely undulated with dusky, a white line above and another beneath the eye, and the alar spot black and green, is plentiful in many parts of Europe and North America; while the blue-winged teal, *Q. discors*, characterized by the light blue colour of the wing-coverts, is peculiar to the latter continent, as is likewise the American teal, *Q. Carolinensis*.

The second principal group named *Mergidæ*, consisting of the genus Mergus of Linnæus, includes the remaining birds of the great family of Lamellirostres, which are usually designated by the vernacular name of *mergansers*. They differ from the ducks in having their bill slender, almost cylindrical, and furnished on the margins with dentiform points directed backwards, and resembling the teeth of a saw. (Plate CCCCII. fig. 6.) Their summer residence is in the colder regions of both continents, whence they migrate southward on the approach of winter. Their body is elongated and depressed, their feet short and placed far behind, their wings rather long and narrow, their neck of moderate length. They fly with rapidity, swim and dive with the greatest facility, and generally feed on fishes. In their habits they are intermediate between the ducks and divers; but in their organization and plumage they are more nearly allied to the former. Their tracheæ, besides having an exceedingly large dilatation at its bifurcation, is also enlarged previous to its entrance into the thorax. In accordance with their piscivorous propensities, their gullet is wider than that of the ducks, and their gizzard less muscular.

Three species occur in the temperate parts of Europe. The goosander, *Mergus merganser*, of which the male is black, with the lower parts buff-coloured, and the head purplish green, with a slender elongated crest; the red-breasted merganser, *M. serrator*, about the size of the mallard, also crested, the male black above, white beneath, with the head dark green; and the smew, *M. albellus*, which is smaller than the golden-eye, varied with black and white, and having a large compressed white crest. All these occur also in the northern parts of America, which has moreover a species peculiar to itself, the hooder merganser, *M. cucullatus* (Plate CCCCII. fig. 7), of a blackish colour above, white beneath, with a semicircular black crest, white on each side. The females and young of all the species differ greatly in colour from the adult males. (T.)

THE ORDERS, FAMILIES, AND GENERA, OF BIRDS, ACCORDING TO THE SYSTEM OF ILLIGER.[1]

Order I.—Scansores.

Family *Psittacini*...........	Gen. Psittacus, Pezoporus (πεζοπορος, pedester).
Family *Serrati*..............	Gen. Rhamphastos, Pteroglossus (πτερον, *penna*, γλοσσα, *lingua*), Pogonias (πωγωνιας, *barbatus*), Corythaix (κορυθαιξ, *galea*, *cristam movens*), Trogon, Musophaga.
Family *Amphiboli*..........	Gen. Crotophaga, Scythrops, Bucco, Cuculus, Centropus (κεντριν, *stimulus*, *calcar*; πους, *pes*).
Family *Sagittilingues*.......	Gen. Yunx, Picus.
Family *Syndactyli*	Gen. Galbula.

Order II.—Ambulatores.

Family *Angulirostres*.......	Gen. Alcedo, Merops.
Family *Suspensi*............	Gen. Trochilus.
Family *Tenuirostres*.........	Gen. Nectarinia (*nectar florum haurientes*), Tichodroma (τειχος, *murus*, δρομος, *cursitans*), Upupa.

[1] *Prodromus Mammalium et Avium*, Berlin, 1811.

Illiger's Arrangement.

Family *Pygarrhichi*	Gen. Certhia, Dendrocolaptes.
Family *Gregarii*	Gen. Xenops (ξενος, *inusitatus, novus*, ωψ, *vultus*), Sitta, Buphaga, Oriolus, Cassicus, Sturnus.
Family *Canori*	Gen. Turdus, Cinclus, Accentor, Motacilla, Muscicapa, Myiothera (μυια, *musca*, θηραω, *venor, capto*), Lanius, Sparactes (σπαρακτης, *lanio, lacerator*), Todus, Pipra.
Family *Passerini*	Gen. Parus, Alauda, Emberiza, Tanagra, Fringilla, Loxia, Colius, Glaucopis, Phytotoma.
Family *Dentirostres*	Gen. Prionites (πριων, *serra*), Buceros.
Family *Coraces*	Gen. Corvus, Coracias, Paradisea, Cephalopterus, Gracula.
Family *Sericati*	Gen. Ampelis, Procnias.
Family *Hiantes*	Gen. Hirundo, Cypselus, Caprimulgus.

Order III.—Raptores.

Family *Nocturni*	Gen. Strix.
Family *Accipitrini*	Gen. Falco, Gypogeranus (γυψ, *vultur*, γερανος, *grus*), Gypaëtus.
Family *Vulturini*	Gen. Vultur, Cathartes (καθαρτης, *purgator*).

Order IV.—Rasores.

Family *Gallinacei*	Gen. Numida, Meleagris, Penelope, Crax, Opisthocomus (Hoffmansegg, οπισθοκομος, *occipite comatus*), Pavo, Phasianus, Gallus, Menura, Tetrao, Perdix.
Family *Epollicati*	Gen. Ortygis (ορτυξ, *coturnix*), Syrrhaptes (συῤῥαπτειν, *consuere*).
Family *Columbini*	Gen. Columba.
Family *Crypturi*	Gen. Crypturus (κρυπτειν, *occultare*, ουρη, *cauda*).
Family *Inepti*	Gen. Didus.

Order V.—Cursores.

Family *Proceri*	Gen. Casuarius, Struthio, Rhea.
Family *Campestres*	Gen. Otis.
Family *Littorales*	Gen. Charadrius, Calidris, Himantopus, Hæmatopus, Tachydromus (ταχυδρομος, *velociter currens*), Burhinus.

Order VI.—Grallatores.

Family *Vaginati*	Gen. Chionis.
Family *Alectorides*	Gen. Glareola, Cereopsis, Dicholophus (διχα, *bifariam*; λοφος, *crista*), Palamedea, Chauna (χαυνος, *fungosus, inflatus, inanis*), Psophia.
Family *Herodii*	Gen. Grus, Ciconia, Ardea, Eurypyga (ευρυς, *latus*, πυγη, *anus, cauda*), Scopus, Cancroma, Anastomus.
Family *Falcati*	Gen. Tantalus, Ibis.
Family *Limicolæ*	Gen. Numenius, Scolopax, Ereunetes (ερευνητης, *explorator*), Actitis (ακτιτις, *in littore degens*), Strepsilas (στρεψειν, *vertere*, λᾶς, *lapis*), Tringa.
Family *Macrodactyli*	Gen. Parra, Rallus, Crex.
Family *Lobipedes*	Gen. Fulica, Podoa (πους, *pes*, ὤα, *limbus, fimbria*), Phalaropus.
Family *Hygrobatæ*	Gen. Corrira, Recurvirostra, Platalea, Phænicopterus.

Order VII.—Natatores.

Family *Longipennes*	Gen. Rhyncops, Sterna, Larus, Lestris (ληστρις, *prædatrix*).
Family *Tubinares*	Gen. Procellaria, Haladroma (αλαδρομας, *in mare cursitans*), Pachyptila (παχυς, *densus*, πτιλον, *pluma*), Diomedea.
Family *Lamelloso-dentati*	Gen. Anas, Anser, Mergus.
Family *Steganopodes*	Gen. Pelecanus, Halieus (αλιευς, *piscator*), Dysporus, Phaëton, Plotus.
Family *Pygodopes*	Gen. Colymbus, Eudytes (ευ, *bene, facile*, δυτης, *urinator*), Uria, Mormon (μορμων, *larva*), Alca.
Family *Impennes*	Gen. Aptenodytes.

Temminck's and Vigors's Systems.

THE ORNITHOLOGICAL SYSTEM OF M. TEMMINCK.[1]

Order I.—Rapaces.

Genera.—Vultur, Cathartes, Gypætus, Gypogeranus, Falco, Strix.

Order II.—Omnivores.

Genera.—Opisthocomus, Buceros, Prionites, Corvus, Nucifraga, Pyrrhocorax, Barita, Glaucopis, Gracula, Buphaga, Bombycivora, Ptilonorhynchus, Coracias, Colaris, Oriolus, Icterus, Sturnus, Pastor, Paradisea, Lamprotornis.

Order III.—Insectivores.

Genera.—Turdus, Cinclus, Menura, Pitta, Myothera, Tamnophilus, Vanga, Lanius, Psaris, Sparactes, Ocypterus, Criniger, Edolius, Ceblepyris, Coracina, Ampelis, Casmarhinchos, Procnias, Rupicola, Phibalura, Pipra, Pardalotus, Todus, Platyrhinchos, Muscipeta, Muscicapa, Malurus, Sylvia, Saxicola, Accentor, Motacilla, Anthus.

Order IV.—Granivores.

Genera.—Alauda, Parus, Emberiza, Tanagra, Ploceus, Loxia, Psittirostra, Pyrrhula, Fringilla, Phytotoma, Colius.

Order V.—Zygodactyli.

First Family.

Genera.—Musophaga, Indicator, Cuculus, Coccyzus, Centropus, Phœnicophaus, Leptosomus, Scythrops, Pteroglossus, Ramphastos, Crotophaga, Trogon, Capito, Bucco, Pogonias, Psittacus.

Second Family.

Genera.—Picus, Yunx.

Order VI.—Anisodactyli.

Genera.—Oxyrincus, Orthonyx, Dendrocolaptes, Xenops, Anabates, Opetiorynchos, Certhia, Cereba, Trochilus, Nectarinia, Climacteris, Tichodroma, Upupa, Epimachus, Drepanis, Meliphaga.

Order VII.—Alciones.

Genera.—Merops, Alcedo, Dacelo.

Order VIII.—Chelidones.

Genera.—Hirundo, Cypselus, Caprimulgus.

Order IX.—Columbæ.

Genus.—Columba.

Order X.—Gallinæ.

Genera.—Pavo, Gallus, Phasianus, Lophophorus, Polyplectron, Meleagris, Argus, Numida, Pauxi, Crax, Penelope, Tetrao, Pterocles, Syrrhaptes, Perdix, Cryptonyx, Tinamus, Hemipodius.

Order XI.—Alectorides.

Genera.—Psophia, Dicholophus, Glareola, Palamedea, Chauna.

Order XII.—Cursores.

Genera.—Struthio, Rhea, Casuarius, Otis, Cursorius.

Order XIII.—Grallatores.

First Family.

Geuera.—Œdicnemus, Calidris, Falcinellus, Himantopus, Hæmatopus, Charadrius.

Second Family.

Genera.—Vanellus, Strepsilus, Grus, Aramus, Ardea, Ciconia, Anastomus, Scopus, Phœnicopterus, Recurvirostra, Cancroma, Platalea, Tantalus, Ibis, Numenius, Tringa, Totanus, Limosa, Scolopax, Rynchæa, Eurypyga, Rallus, Gallinula, Parra, Porphyrio.

Order XIV.—Pinnatipedes.

Genera.—Fulica, Podoa, Phalaropus, Podiceps.

Order XV.—Palmipedes.

Genera.—Cereopsis, Chionis, Rynchops, Sterna, Larus, Lestris, Procellaria, Pachyptila, Haladroma, Diomedea, Anas, Mergus, Pelecanus, Carbo, Tachypetes, Sula, Plotus, Phaëton, Uria, Phaleris, Mormon, Alca, Spheniscus, Aptenodytes.

Order XVI.—Inertes.

Genera.—Apteryx, Didus.

THE CLASSIFICATION OF BIRDS, AS PROPOSED BY MR VIGORS.[2]

Order I.—Raptores, Ill. (Accipitres, Linn.)

1st Family. —— ?—Gen. Gypogeranus, Ill. (Serpentarius, Cuv.; Ophiotheres, Vieill.).

2d Family. Vulturidæ.—1. —— Gen. Cathartes, Ill. (Catharista, Vieill.); 2. —— Gen. Sarcoramphus, Dum. (Cathartis pars, Ill.; Gypagus, Vieill.); 3. —— Gen. Gyps, Sav.; Vultur, Auct. (Ægypius, Sav.); 4. —— Gen. Gypætus, Storr. (Phene, Sav.); 5. —— Gen. Neophron, Sav. (Cathartis pars, Temm.).

3d Family. Falconidæ, Leach.—1. Sub-fam. *Aquilina.* Gen. Ibycter, Vieill.; Daptrius, Vieill.; Polyborus, Vieill.; Pandion, Sav.; Haliæetus, Sav.; Aquila, Auct.; Harpyia, Cuv.; Physeta, Vieill.; Morphnus, Cuv. (Spizaëtus, Vieill.); Cymindis, Cuv.; Asturina, Vieill. 2. Sub-fam. *Accipitrina.* Gen. Dædalion, Sav.; Astur, Auct. (Sparvius, Vieill.); Accipiter, Auct.; Harpagus; Gampsonyx. 3. Sub-fam. *Falcouina.* Gen. Hierax, Vig.; Falco, Auct. 4. Sub-fam. *Buteonina.* Gen. Ictinia, Vieill.; Circus, Auct.; Pernis, Cuv.; Buteo, Auct. 5. Sub-fam. *Milvina.* Gen. Elanus, Sav.; Nauclerus, Vig.; Milvus, Auct.

4th Family. Strigidæ, Leach.—1. Sub-fam. *Noctuina.* Gen. Surnia, Dum.; Noctua, Sav. 2. Sub-fam. *Bubonina.* Gen. Scops, Sav.; Bubo, Cuv. 3. Sub-fam. *Asionina.* Gen. Asio, Antiq. (Olus, Cuv.). 4. Sub-fam. *Strigina.* Gen. Ulula, Cuv.; Strix, Auct. 5. Sub-fam. *Syrniana.* Gen. Syrnium, Linn.

5th Family. —— ?

[1] From the *Manuel d'Ornithologie*, i. xlviii. 1820.

[2] In the *Zoological Journal*, No. vii. p. 392. 1825.

Vigors's System.

ORDER II.—INSESSORES. (Picæ, Passeres, Linn.)

Tribe I.—Fissirostres, Cuv.

1ST FAMILY. MEROPIDÆ.—Gen. Merops, Linn. (Apiaster, Briss.).

2D FAMILY. HIRUNDINIDÆ.—Gen. Cypselus, Ill. (Apus, Cuv.; Micropus, Meyer); Hirundo, Auct.

3D FAMILY. CAPRIMULGIDÆ.—Gen. Caprimulgus, Auct.; Podargus, Cuv.; Ægotheles, Vig. and Hors.; Steatornis, Humb.; Nyctebius, Vieill.

4TH FAMILY. TODIDÆ.—Gen. Eurylaimus, Horsf.; Eurystomus, Vieill. (Colaris, Cuv.); Todus, Auct.

5TH FAMILY. HALCYONIDÆ.—Gen. Alcedo, Linn. (Ispida, Briss.); Halcyon, Swains.; Dacelo, Leach; Tanysiptera, Vig.; Galbula, Briss.; Capito, Vieill.? Monasa, Vieill.?

Tribe II.—Dentirostres, Cuv.

1ST FAMILY. MUSCICAPIDÆ.—Gen. Platyrhynchus, Desm.; Muscicapa, Auct.; Muscipeta, Cuv.; Onychorhynchus, Fisch.; Vireo, Vieill.? Icteria, Vieill.?

2D FAMILY. LANIADÆ.—1. Sub-fam. *Tyrannina*, Swains. Gen. Tyrannus, Cuv.; Tityra, Vieill. (Psaris, Cuv.); Gubernetes, Such. 2. Sub-fam. *Dicrurina*, Swains. Gen. Artamus, Vieill. (Ocypterus, Cuv.); Dicrurus, Vieill. (Edolius, Cuv.); Trichophorus, Temm.? Irena, Horsf. 3. Sub-fam. *Laniana*, Swains. Gen. Sparactes, Ill.; Lanius, Auct.; Falcunculus, Vieill.; Cyclarhis, Swains.; Lanio, Vieill.? 4. Sub-fam. *Thamnophilina*, Swains. Gen. Vanga, Cuv.; Thamnophilus, Vieill.; Malaconotus, Swains.; Formicivora, Swains.; Drymophila, Swains.; Laniarius, Vieill.; Prionops, Vieill. 5. Sub-fam. *Campephagina*, Swains. Gen. Grauculus, Cuv.; Campephaga, Vieill. (Ceblepyris, Cuv.).

3D FAMILY. MERULIDÆ.—1. Sub-fam. *Myotherina*, Swains. Gen. Urotomus, Swains.; Myothera, Ill. (Myrmothera, Vieill.); Pitta, Vieill.; Grallaria, Vieill.; Conophaga, Vieill.; Cinclus, Bechst.? (Hydrobata, Vieill.); Chamæza, Vig. 2. Sub-fam. *Merulina*. Gen. Merula, Ray; Sphecotheres, Vieill.? 3. Sub-fam. *Oriolina*. Gen. Oriolus, Auct. 4. Sub-fam. *Cossyphina*. Gen. Cossypha, Vig.; Timalia, Horsf.? 5. Gen. Petrocincla, Vig.

4TH FAMILY. SYLVIADÆ.—1. ——? Gen. Hylophilus, Temm.; Iora, Horsf.; Accentor, Bechst.; Prunella, Gessn.? 2. ——? Gen. Brachypteryx, Horsf.; Curruca, Bechst.; Ficedula, Bechst.; Œgithina, Vieill.? 3. Sub-fam. *Sylviana*. Gen. Sylvia, Auct.; Melizophilus, Leach; Synallaxis, Vieill.; Malurus, Vieill.; Troglodytes, Cuv.; Regulus, Cuv.; Tyrannulus, Vieill. 4. Sub-fam. *Motacillina*. Gen. Motacilla, Auct.; Budytes, Cuv.; Enicurus, Temm.; Anthus, Bechst.; Corydalla, Vig.; Megalurus, Horsf. 5. Sub-fam. *Saxicolina*. Gen. Saxicola, Bechst. (Œnanthe, Vieill.).

5TH FAMILY. PIPRIDÆ.—Gen. Ægithalus, Vig.; Parus, Linn.; Megistina, Vieill.; Pardalotus, Vieill.; Pipra, Linn. (Manacus, Briss.); Rupicola, Briss.; Calyptomena, Raffles; Phibalura, Vieill.; Bombicilla, Briss.; Ampelis, Auct. (Cotinga, Briss.; Tersa, Vieill.); Procnias, Hoffm.; Casmarhynchus, Temm. (Ampelis, Vieill.); Querula, Vieill.; Coracina, Vieill. (Cephalopterus, Geoff.); Pachycephala, Swains.

Tribe III.—Conirostres, Cuv.

1ST FAMILY. FRINGILLIDÆ.—1. Sub-fam. *Tanagrina?* Gen. Euphonia, Vieill.; Nemosia, Vieill.; Tachyphonus, Vieill.; Saltator, Vieill.; Tanagra, Auct.; Pyranga, Vieill.; Ramphopis, Vieill.; Arremon, Vieill.; Dulus, Vieill.? Pipilo, Vieill. 2. Sub-fam. *Alaudina*. Gen. Emberiza, Linn.; Passerina, Vieill.; Alauda, Auct.; Mirafra, Horsf. 3. Sub-fam. *Carduelina*. Gen. Carduelis, Briss.; Ploceus, Cuv. (Agelaii pars, Vieill.). 4. Sub-fam. *Passerina*. Gen. Fringilla, Auct.; Passer, Auct. (Pyrgita, Cuv.). 5. Sub-fam. *Pyrrhulina?* Gen. Linaria, Bechst.; Vidua, Cuv.; Pyrrhula, Briss.?

2D FAMILY. STURNIDÆ.—1. Sub-fam. *Icterina*. Gen. Xanthornus, Cuv. (Yphantes, Vieill.); Icterus, Cuv. (Pendulinus, Vieill.); Sycobius, Vieill.? Quiscalus, Vieill.; Cassicus, Daud.; Leïstes (Agelaii pars, Vieill.). 2. Sub-fam. *Sturnina*. Gen. Sturnella, Vieill.; Sturnus, Linn.; Amblyramphus, Leach; Dilophus, Vieill.? 3. ——? Gen. Lamprotornis, Temm.; Acridotheres, Vieill. (Gracula, Cuv.). 4. ——? Gen. Pastor, Temm. (Psaroidos, Vieill.); Grallina, Vieill.? 5. ——? Gen. Buphaga, Linn.

3D FAMILY. CORVIDÆ, Leach.—1. ——? Gen. Cracticus, Vieill. (Barita, Cuv.); Nucifraga, Briss. 2. Sub-fam. *Corvina*. Gen. Pica, Briss.; Garrulus, Briss.; Corvus, Auct. 3. Sub-fam. *Coraciana*. Gen. Coracias, Linn. (Galgulus, Briss.); Gracula, Auct. (Eulabes, Cuv.); Ptilonorhynchus, Kuhl; Glaucopis, Forst. (Callæas, Lath.); Crypsirina, Vieill. (Phrenotrix, Horsf.). 4. Sub-fam. *Paradiseana*. Astrapia, Vieill.; Parotia, Vieill.; Paradisea, Linn. (Manucodiata, Briss.); Lophorina, Vieill.; Cicinnurus, Vieill.; Epimachus, Cuv.? 5. ——? Gen. Fregilus, Cuv. (Coracias, Briss.); Pyrrhocorax, Vieill.

4TH FAMILY. BUCERIDÆ, Leach.—Gen. Buceros, Linn. (Hydrocorax, Briss.); Momotus, Briss. (Prionites, Ill.; Baryphonus, Vieill.).

5TH FAMILY. LOXIADÆ.—Gen. Phytotoma, Gmel.; Coccothraustes, Briss.; Pytilus, Cuv.; Loxia, Briss.; Psittirostra, Temm.; Colius, Linn.? Cissopis, Vieill. (Bethylus, Cuv.); Strobilophaga, Vieill. (Corythus, Cuv.).

Tribe IV.—Scansores, Auct.

1ST FAMILY. RAMPHASTIDÆ.—Gen. Scythrops, Lath.; Ramphastos, Linn. (Tucana, Briss.); Pteroglossus, Ill.

2D FAMILY. PSITTACIDÆ, Leach.—1. Sub-fam. *Psittacina*. Gen. Psittacus, Auct.; Androglossa. 2. Sub-fam. *Plyctolophina*. Gen. Plyctolophus, Vieill.; Calyptorhynchus, Vig. and Hors.; Microglossum, Geoff. 3. Sub-fam. *Macrocercina*. Gen. Macrocercus, Vieill. 4. Sub-fam. *Palæornina*. Gen. Psittacara; Nanodes, Vig. and Hors.; Platycercus; Pezoporus, Ill.; Palæornis, Vig.; Trichoglossus, Vig. and Hors.; Lorius, Vig.; Brotogeris, Vig. 5. Sub-fam. *Psittaculina*. Gen. Psittacula, Kuhl.

3D FAMILY. PICIDÆ.—Gen. Pogonias, Ill.; Bucco, Auct.; Picus, Linn.; Colaptes, Swains.; Yunx, Linn. (Torquilla, Briss.).

4TH FAMILY. CERTHIADÆ.—Gen. Dendrocolaptes, Herm. (Dendrocopus, Vieill.); Certhia, Auct.; Climacteris, Temm.; Orthonyx, Temm.; Tichodroma, Ill. (Petrodroma, Vieill.); Upupa, Linn.; Sitta, Linn.; Xenops, Hoffm.; Orthotomus, Horsf.; Neops, Vieill.; Mniotilta, Vieill.; Thriothurus, Vieill.; Pyrrota, Vieill.? Opetiorhynchus, Temm.; Oxyrhynchus, Temm.

5TH FAMILY. CUCULIDÆ, Leach.—Gen. Coccyzus, Vieill.; Leptosomus, Vieill.; Cuculus, Auct.; Indicator, Vieill.; Centropus, Ill. (Corydonyx, Vieill.); Saurothera, Vieill.; Phænicophaus, Vieill.; Crotophaga, Linn.; Trogon, Linn.; Corythaix, Ill.? (Opæthus, Vieill.); Musophaga, Isert.?

Tribe V.—Tenuirostres, Cuv.

1ST FAMILY. NECTARINIADÆ?—Gen. Nectarinia, Ill.; (Cæreba, Vieill.); Dacnis, Cuv.; Furnarius, Vieill.?

2D FAMILY. CYNNYRIDÆ.—Gen. Cinnyris, Cuv. (Mellisuga, Vieill.); Dicæum, Cuv.; Drepanis, Temm.

3D FAMILY. TROCHILIDÆ.—Gen. Trochilus, Auct. (Polytmus, Briss.); Mellisuga, Briss. (Orthorhynchus, Lacepede).

4TH FAMILY. PROMEROPIDÆ.—Gen. Promerops, Briss. (Falcinellus, Vieill.).

5TH FAMILY. MELIPHAGIDÆ.—Gen. Meliphaga, Lewin

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(Philedon, Cuv.; Philemon, Vieill.); Melithreptus, Vieill.; Creadion, Vieill.; Mimetes, King? Sericulus, Swains.? Ptiloris, Swains.; Pomatorhinus, Horsf.? Prinia, Horsf.?

ORDER III.—RASORES, Ill. (Gallinæ, Linn.)

1st Family. Columbidæ, Leach.—Gen. Treron, Vieill. (Vinago, Cuv.); Columba, Auct.; Ptilinopus, Swains.; Lophyrus, Vieill.

2d Family. Phasianidæ.—Gen. Meleagris, Linn. (Gallopavo, Briss.); Pavo, Linn.; Diplectron, Vieill. (Polyplectron, Temm.); Gallus, Briss.; Monaulus, Vieill. (Lophophorus, Temm.); Phasianus, Auct.; Argus, Temm.; Numida, Linn. (Melegris, Briss.).

3d Family. Tetraonidæ, Leach.—Gen. Liponyx, Vieill. (Cryptonyx, Temm.); Odontophorus, Vieill.; Coturnix, Cuv.; Perdix, Briss.; Ganga, Vieill. (Pterocles, Temm.); Tetrao, Auct.; Lagopus, Vieill.; Syrrhaptes, Ill. (Heteroclitus, Vieill.); Ortygis, Ill. (Ortygodes, Vieill.; Hemipodius, Temm.); Tinamus, Lath. (Crypturus, Ill.; Cryptura, Vieill.).

4th Family. Struthionidæ.—Gen. Rhea, Briss.; Struthio, Linn.; Casuarius, Briss.; Dromiceius, Vieill.; Didus, Linn. (Raphus, Briss.); Otis, Linn.

5th Family. Cracidæ.—Gen. Ourax, Cuv. (Pauxi, Temm.); Crax, Linn.; Penelope, Merr.; Ortalida, Merr.; Opisthocomus, Hoffm.? (Orthocorys, Vieill.); Menura, Lath.; Megapodius, Temm.

ORDER IV.—GRALLATORES, Ill. (Grallæ, Linn.)

1st Family. Gruidæ.—Gen. Psophia, Linn.; Anthropoïdes, Vieill.; Balearica, Briss.; Grus, Pall.; Cariama, Briss. (Dicholophus, Ill.; Zophorhynchus, Vieill.; Macrodactylus, Geoff.).

2d Family. Ardeidæ, Leach.—Gen. Aramus, Vieill.; Eurypyga, Ill. (Helias, Vieill.); Ardea, Auct.; Canchroma, Linn. (Cochlearius, Briss.); Phænicopterus, Linn.; Platalea, Linn. (Platea, Briss.); Ciconia, Briss.; Mycteria, Linn.; Scopus, Briss.; Anastomus, Ill. (Hians, Lacep.); Tantalus, Linn.; Ibis, Lacep. (Falcinellus, Bechst.).

3d Family. Scolopacidæ.—Gen. Numenius, Briss.; Totanus, Bechst. (Actitis pars., Ill.); Recurvirostra, Linn. (Avocetta, Briss.); Limosa, Briss. (Actitis pars., Ill.; Limicula, Vieill.); Ereunetes, Ill.: Macroramphus, Leach? Scolopax, Auct.; Rusticola, Vieill.; Rynchæa, Cuv. (Rostratula, Vieill.); Machetes, Cuv. (Actitis pars., Ill.); Pelida, Cuv.; Phalaropus, Briss. (Crymophilus, Vieill.); Lobipes, Cuv. (Phalaropus, Vieill.); Tringa, Auct. (Actitis pars., Ill.); Phæopus, Cuv.

4th Family. Rallidæ, Leach.—Gen. Parra, Linn. (Jacana, Briss.); Palamedea, Linn. (Anhima, Briss.); Chauna, Ill. (Opistolophus, Vieill.); Glareola, Briss.; Rallus, Auct.; Chionis, Forst.? (Vaginalis, Gmel.); Crex, Bechst. (Ortygometra, Steph.); Gallinula, Briss.; Porphyrio, Briss.; Podoa, Ill. (Heliornis, Vieill.); Fulica, Auct.

5th Family. Charadriadæ, Leach.—Gen. Hæmatopus, Linn. (Ostralega, Briss.); Calidris, Ill. (Arenaria, Briss.); Falcinellus, Cuv.; Erolia, Vieill.? Cursorius, Lath. (Tachydromus, Ill.); Strepsilas, Ill.; Squatarola, Cuv.; Vanellus, Briss. (Tringa, Ill.); Pluvianus, Vieill.; Charadrius, Auct. (Pluvialis, Briss.); Burhinus, Ill.? Himantopus, Briss. (Macrotarsus, Lacep.); Œdicnemus, Cuv.

ORDER V.—NATATORES, Ill. (Anseres, Linn.)

1st Family.—Anatidæ, Leach.—1. Sub-fam. *Anserina.* Gen. Anser, Briss.; Bernicla, Steph.; Cheniscus, Brookes's MS.; Chenalopex, Steph.; Plectropterus, Leach. 2. Sub-fam. *Cereopsina.* Gen. Cereopsis, Lath. 3. Sub-fam. *Anatina.* Gen. Tadorna, Leach; Cairina, Flem.; Anas, Auct.; Dafila, Leach; Mareca, Steph.; Querquedula, Ray; Rhynchaspis, Leach. 4. Sub-fam. ——? Gen. Clangula, Flem.; Harelda, Ray; Fuligula, Ray; Mergus, Linn. (Merganser, Briss.); Somateria, Leach; Oidemia, Flem.; Biziura, Leach. 4. Sub-fam. *Cygnina.* Gen. Cygnus, Meyer.

2d Family. Colymbidæ, Leach.—Gen. Podiceps, Lath. (Colymbus, Briss. Ill.); Colymbus, Auct. (Mergus, Briss.; Eudytes, Ill.).

3d Family. Alcadæ.—Gen. Uria, Briss.; Cephus, Cuv.? Mergulus, Ray; Phaleris, Temm. (Alca, Vieill.); Fratercula, Briss. (Mormon, Ill.; Larvæ pars, Vieill.); Alca, Auct. (Larvæ pars, Vieill.); Spheniscus, Briss.; Catarractes, Briss. (Eudytes, Vieill.); Aptenodytes, Forst.

4th Family. Pelecanidæ, Leach.—Gen. Onocrotalus, Briss.; Phalacrocorax, Briss. (Carbo, Meyer; Halieus, Ill.; Hydrocorax, Vieill.); Sula, Briss. (Dysporus, Ill.; Morus, Vieill.); Tachypetes, Vieill.; Phaëton, Linn. (Lepturus, Briss.); Plotus, Linn. (Anhinga, Briss.).

5th Family. Laridæ, Leach.—Gen. Sterna, Linn.; Rhynchops, Linn. (Rygchopsalia, Briss.); Larus, Auct.; Stercorarius, Briss. (Lestris, Ill.; Prædatrix, Vieill.); Diomedea, Linn. (Albatrus, Briss.); Haladroma, Ill.; Procellaria, Auct.; Pachyptila, Ill.; Puffinus, Ray; Thalassidroma, Vig.

THE ORDERS, FAMILIES, AND SUB-FAMILIES OF BIRDS, ACCORDING TO THE SYSTEM OF MR SWAINSON.[1]

ORDER I.—RAPTORES. RAPACIOUS BIRDS.

Family Vulturidæ. Vultures.

Family Falconidæ. Falcons.—Sub-families: Aquilinæ, Eagles; Cymindinæ, Kites; Buteoninæ, Buzzards; Falconinæ, Falcons; Accipitrinæ, Hawks.

Family Strigidæ. Owls.

ORDER II.—INSESSORES. PERCHING BIRDS.

Tribe I.—Dentirostres.

Family Laniadæ. Shrikes.—Sub-families: Lanianæ, True Shrikes; Thamnophilinæ, Bush Shrikes; Dicrurinæ, Drongo Shrikes; Ceblepyrinæ, Caterpillar-catchers; Tyranninæ, Tyrant Shrikes.

Family Merulidæ. Thrushes.—Sub-families: Brachypodinæ, Short-footed Thrushes; Myotherinæ, Ant Thrushes; Merulinæ, True Thrushes; Crateropodinæ, Babblers; Oriolinæ, Orioles.

Family Sylviadæ. Warblers.—Sub-families: Saxicolinæ, Stonechats; Philomelinæ, Nightingales; Sylvianæ, True Warblers; Parianæ, Tit-mice; Motacillinæ, Wagtails.

Family Ampelidæ. Fruit-eaters, or Chatterers.—Sub-

[1] From the *Natural History and Classification of Birds*, vol. ii. p. 205, published in Dr Lardner's *Cabinet Cyclopædia*, vol. xcii. 1837. The accessible form of this recent work renders it less necessary that we should give a full exposition of its systematic portion, and the great amount of its generic groups renders their insertion somewhat incompatible with those prescribed limits which in truth we have already exceeded. But we take it for granted, that every sincere lover of Ornithology will possess himself of Mr Swainson's volumes, to which any abstract we could offer would do injustice.

Birds of Europe.

families: Leiotrichanæ, Silky Chatterers? Vireoninæ, Greenlets and Thick-heads; Bombycillinæ, Swallow-chatterers; Ampelinæ, Typical Chatterers; Piprinæ, Manakins.

Family Muscicapidæ. Fly-catchers.—Sub-families: Querulinæ; Psarianæ, Black-caps; Fluvicolinæ, Water-chats; Muscicapinæ, Fly-catchers; Eurylaiminæ, Broad-bills.

Tribe II.—Conirostres.

Family Corvidæ. Crows.—Sub-families: Corvinæ, Typical Crows; Garrulinæ, Jays; Glaucopinæ, Wattle-crows; Coracinæ, Fruit-crows; Frigilinæ.

Family Sturnidæ. Starlings.—Sub-families: Sturninæ, Typical Starlings; Lamprotorninæ, Grakles; Scaphidurinæ, Boat-tails; Icterinæ, Hang-nests; Aglainæ, Maizers.

Family Fringillidæ. Finches.—Sub-families: Coccothraustinæ, Hard-bills; Tanagrinæ, Tanagers; Fringillinæ, Ground-finches; Alaudinæ, Larks; Pyrrhulinæ, Bullfinches.

Family Musophagidæ. Plantain-eaters.—Sub-families: Phitotominæ, Plant-cutters; Colinæ, Colies; Musophaginæ, Plantain-eaters.

Family Buceridæ. Genus Buceros.

Tribe III.—Scansores.

Family Ramphastidæ. Toucans.

Family Psittacidæ. Parrots.—Sub-families: Macrocircinæ, Maccaws; Psittacinæ, Parrots; Plyctolophinæ, Cockatoos; Lorianæ, Lories; Platycircinæ, Loriets.

Family Picidæ. Woodpeckers.—Sub-families: Picianæ, True Woodpeckers; Buccoinæ, Barbuts.

Family Certhiadæ. Creepers.—Sub-families: Certhianæ, True Creepers; Anabatinæ, Tree-runners; Sittinæ, Nut-hatchers; Troglodytinæ, Wrens; Buphaginæ, Ox-peckers.

Family Cuculidæ. Cuckoos.—Sub-families: Cuculinæ, Parasitic Cuckoos; Coccyzinæ, Hook-billed Cuckoos; Leptostominæ, Long-billed Cuckoos; Indicatorinæ, Honey-guides.

Tribe IV.—Tenuirostres. Suctorial Birds.

Family Meliphagidæ. Honey-suckers.
Family Cinnyridæ. Sun-birds.
Family Trochilidæ. Humming birds.
Family Promeropidæ. Hoopoes.
Family Paradisiadæ. Paradise Birds.

Tribe V.—Fissirostres. Fissirostral Birds.

Family Meropidæ. Bee-eaters.
Family Halcyonidæ. King-fishers.
Family Trogonidæ. Trogons.
Family Caprimulgidæ. Night-jars.
Family Hirundinidæ. Swallows.

Order III.—Rasores. Rasorial Birds.

Family Pavonidæ. Peacocks and Pheasants.
Family Tetraonidæ. Partridges and Grouse.
Family Struthionidæ. Ostriches.
Family Columbidæ. Pigeons.—Sub-family: Columbinæ.
Family Megapodiadæ. Great-foots.

Order IV.—Grallatores. Waders.

Family Ardeadæ. Herons and Cranes.
Family Tantalidæ. Ibis.
Family Rallidæ. Rails.
Family Scolopacidæ. Sand-pipers and Snipes.
Family Charadriadæ. Plovers.

Order V.—Natatores. Swimmers.

Family Anatidæ. Ducks.—Sub-families: Phænicoptinæ, Flamingoes; Anserinæ, Geese and Swans; Anatinæ, River-ducks; Fuligulinæ, Sea-ducks; Merganinæ, Mergansers.

Family Colymbidæ. Grebes and Divers.
Family Alcadæ. Auks.
Family Pelecanidæ. Pelicans.
Family Laridæ.[1] Gulls.

ENUMERATION OF THE BIRDS OF EUROPE.[2]

Order I.—Raptores.

Vultur fulvus, Linn.	Griffon Vulture.
V. cinereus, Linn.	Cinereous Vulture.
Neophron percnopterus, Sav.	Egyptian Neophron.
Gypaëtus barbatus, Storr.	Lammer-geyer.
Aquila imperialis, Briss.	Imperial Eagle.
A. chrysæta, Briss.	Golden Eagle.
A. Bonelli.	Bonelli's Eagle.
A. nævia, Meyer.	Spotted Eagle.
A. pennata, Steph.	Booted Eagle.
Haliæëtus albicilla, Selby.	Sea-Eagle.
H. leucocephalus, Sav.	White-headed Eagle.
Pandion haliæëtus, Sav.	Osprey.
Circætus brachydactylus, Vieill.	Short-toed Eagle.
Buteo vulgaris, Bechst.	Common Buzzard.
B. lagopus, Flem.	Rough-legged Buzzard.
Pernis apivorus, Cuv.	Honey Buzzard.
Astur palumbarius, Bechst.	Goshawk.
Falco islandicus, Lath.	Jer-Falcon.
F. lanarius, Linn.	Lanner Falcon.
Falco peregrinus, Linn.	Peregrine Falcon.
F. subbuteo, Linn.	Hobby.
F. rufipes, Bechst.	Red-footed Falcon.
F. æsalon, Temm.	Merlin.
F. concolor, Temm.	Lead-coloured Falcon.
F. tinnunculus, Linn.	Kestril.
F. tinnunculoides, Natt.	Lesser Kestril.
Milvus vulgaris, Flem.	Kite.
M. ater.	Black Kite.
Nauclerus furcatus, Vig.	Swallow-tailed Kite.
Elanus melanopterus, Leach.	Black-tailed Kite.

[1] This and the preceding family are placed as sub-families in Mr Swainson's synopsis,—we presume, by an oversight in typographical correction. A similar inadvertency occurs among the tenuirostral tribe.

[2] From Mr Gould's *Birds of Europe*, recently completed in five volumes royal folio, 1837. According to the author of this sumptuous work, the number of European birds may now be stated to amount to 462 species, of which 310 may be regarded as British. Of the latter, about 170 are permanent residents in our island, eighty-five are summer birds of passage, which visit us from the south, and forty-five are winter birds of passage, which visit us from the north. This seems to leave ten species unaccounted for: these may probably be regarded as accidental stragglers. We may add, that Mr Doubleday, in his *Nomenclature of British Birds* (1836), states the total number of species actually killed or captured in Britain as amounting to 323, of which the *Raptores* are thirty, the *Insessores* 117, the *Rasores* seventeen, the *Grallatores* sixty-six, and the *Natatores* ninety-three.

Birds of Europe.

Circus rufus, Briss.	Marsh Harrier.
C. cyaneus, Meyer.	Hen Harrier.
C. pallidus, Sykes.	Pallid Harrier.
C. cineraceus, Meyer.	Ash-coloured Harrier.
Strix flammea, Linn.	Barn Owl.
Bubo maximus, Sibb.	Great-horned or Eagle Owl.
B. ascalaphus, Sav.	Eastern Great-horned Owl.
Otus vulgaris, Flem.	Long-eared Owl.
O. brachyotus, Cuv.	Short-eared Owl.
Scops Aldrovandi, Will. and Ray.	Scops-eared Owl.
Surnia cinerea.	Great Cinereous Owl.
S. nyctea, Dum.	Snowy Owl.
S. Uralensis, Dum.	Ural Owl.
S. funerea, Dum.	Hawk Owl.
Ulula nebulosa, Cuv.	Barred Owl.
Syrnium aluco, Sav.	Tawny or Wood Owl.
Noctua nudipes, Wils.	Little Owl.
N. ? tengmalmi, Selby.	Tengmalm's Owl.
N. passerina.	Sparrow Owl.

ORDER II.—INSESSORES.[1]

Caprimulgus Europæus, Linn.	European Goat-sucker.
C. ruficollis.	Red-collared Goat-sucker.
Cypselus murarius, Temm.	Swift.
C. alpinus, Temm.	White-bellied Swift.
Hirundo rustica, Linn.	Chimney Swallow.
H. rufula, Temm.	Rufous Swallow.
H. rupestris, Linn.	Rock-Martin.
H. urbica, Linn.	Martin.
H. riparia, Linn.	Sand-Martin.
Merops apiaster, Linn.	Bee-eater.
Coracias garrulus, Linn.	Roller.
Alcedo ispida, Linn.	Kingfisher.
A. rudis, Linn.	Black and White Kingfisher.
Muscicapa luctuosa, Temm.	Pied Fly-catcher.
M. albicollis, Temm.	White-collared Fly-catcher.
M. parva, Bechst.	Red-breasted Fly-catcher.
M. grisola, Linn.	Spotted Fly-catcher.
Collurio excubitor, Vig.	Great Shrike.
C. meridionalis, Vig.	Great Gray Shrike.
C. minor, Vig.	Lesser Gray Shrike.
Lanius collurio, Linn.	Red-backed Shrike.
L. rufus, Briss.	Wood-Chat.
Oriolus galbula, Linn.	Golden Oriole.
Merula vulgaris, Ray.	Black Ouzel or Blackbird.
M. torquata, Briss.	Ring-Ouzel.
M. migratoria, Swains.	Migratory Ouzel.
Turdus atrogularis, Temm.	Black-throated Thrush.
T. pilaris, Linn.	Fieldfare.
T. viscivorus, Linn.	Missel-Thrush.
T. musicus, Linn.	Song-Thrush.
T. iliacus, Linn.	Redwing.
T. Naumannii, Temm.	Naumann's Thrush.
T. pallidus, Pall.	Pallid Thrush.
T. Whitei, Eyton.	White's Thrush.
T. Sibericus, Pall.	Siberian Thrush.
Cinclus aquaticus, Bechst.	Water-Ouzel.
C. melanogaster, Brehm.	Black-bellied Water-Ouzel.
C. Pallasii, Temm.	Pallas's Water-Ouzel.
Petrocincla saxatilis, Vig.	Rock-Thrush.
P. cyanea, Vig.	Blue Thrush.
Saxicola cachinnans, Temm.	Black Wheat-ear.
S. leucomela, Temm.	Pied Wheat-ear.
S. œnanthe, Bechst.	Wheat-ear.
S. stapazina, Temm.	Russet Wheat-ear.
S. aurita, Temm.	Black-eared Wheat-ear.

Saxicola rubetra, Bechst.	Whinchat.
S. rubicola, Bechst.	Stonechat.
Phœnicura ruticilla, Swains.	Redstart.
Ph. tithys, Jard. and Selb.	Black Redstart.
Ph. suecica, Jard. and Selb.	Blue-throated Warbler.
Erythaca rubecula, Swains.	Robin.
Accentor alpinus, Bechst.	Alpine Accentor.
A. modularis, Cuv.	Hedge Accentor.
A. montanellus, Temm.	Mountain Accentor.
Locustella fluviatilis.	Reed Locustelle.
L. avicula, Ray.	Brake Locustelle.
L. luscinoides.	Willow Locustelle.
L. certhiola.	Creeping Locustelle.
Salicaria turdoides, Selb.	Great Sedge Warbler.
S. olivetorum, Strickl.	Olive-tree Salicaria.
S. arundinacea, Selb.	Reed Wren.
S. palustris.	Marsh Warbler.
S. phragmitis, Selb.	Sedge Warbler.
S. melanopogon.	Moustached Warbler.
S. aquatica.	Aquatic Warbler.
S. galactotes.	Rufous Sedge Warbler.
S. cisticola.	Fan-tail Warbler.
S. ? Cetti.	Cetti's Warbler.
S. ? sericea.	Silky Warbler.
Philomela luscinia, Swains.	Nightingale.
Ph. turdoides, Blyth.	Thrush Nightingale.
Calliope Lathamii.	Gorget Warbler.
Curruca Orphea.	Orpheus Warbler.
C. atricapilla, Bechst.	Black-cap.
C. hortensis, Bechst.	Garden Warbler.
C. Rupellii.	Ruppell's Warbler.
C. melanocephala, Lath.	Sardinian Warbler.
C. leucopogon.	Sub-alpine Warbler.
C. cinerea, Bechst.	Common White-throat.
C. garrula, Bechst.	Lesser White-throat.
C. conspicillata.	Spectacle Warbler.
C. sarda.	Marmora's Warbler.
C. nisoria.	Barred Warbler.
Melizophilus provincialis, Leach.	Dartford Warbler.
Troglodytes Europæus, Cuv.	Wren.
Sylvia trochilus, Gmel.	Willow Wren.
S. rufa, Lath.	Chiff-Chaff.
S. sibilatrix, Bechst.	Wood Wren.
S. icterina, Vieill.	Yellow Willow Wren.
S. hippolais, Temm.	Melodious Willow Wren.
S. Nattereri, Temm.	Natterer's Warbler.
Anthus Richardi, Vieill.	Richard's Pipit.
A. pratensis, Bechst.	Meadow Pipit.
A. rufescens, Temm.	Tawny Pipit.
A. aquaticus, Bechst.	Rock or Shore Pipit.
A. arboreus, Bechst.	Tree Pipit.
A. rufogularis, Temm.	Red-throated Pipit.
Motacilla Yarrellii.	Pied Wagtail.
M. lugubris, Pall.	White-winged Wagtail.
M. alba, Linn.	White Wagtail.
M. neglecta, Gould.	Gray-headed Wagtail.
M. boarula, Lath.	Gray Wagtail.
Regulus ignicapillus, Cuv.	Fire-crested Wren.
R. vulgaris, Cuv.	Golden-crested Wren.
R. modestus.	Dalmatian Regulus.
Parus major, Linn.	Great Tit.
P. lugubris, Natt.	Sombre Tit.
P. Sibericus, Gmel.	Siberian Tit.
P. bicolor, Linn.	Toupet Tit.

[1] Including the SCANSORES of the preceding Treatise.

Birds of Europe.

Parus cyanus, Pall.	Azure Tit.
P. cæruleus, Linn.	Blue Tit.
P. ater, Linn.	Cole Tit.
P. palustris, Linn.	Marsh Tit.
P. cristatus, Linn.	Crested Tit.
P. caudatus, Linn.	Long-tailed Tit.
Calamophilus biarmicus, Leach.	Bearded Tit, or Reed Bird.
Œgithalus pendulinus, Vig.	Penduline Tit.
Bombycivora garrula, Temm.	Waxen Chatterer.
Alauda tartarica, Pall.	
A. calandra, Pall.	Calandra Lark.
A. brachydactyla, Temm.	Short-toed Lark.
A. alpestris, Linn.	Shore-Lark.
A. cristata, Linn.	Crested Lark.
A. arvensis, Linn.	Sky-Lark.
A. arborea, Linn.	Wood-Lark.
Certhilauda bifasciata.	Bifasciated Lark.
Plectrophanes Lapponica, Selb.	Lark-heeled Bunting.
Pl. nivalis, Meyer.	Snow-Bunting.
Emberiza miliaria, Linn.	Common Bunting.
E. melanocephala, Scop.	Black-headed Bunting.
E. citrinella, Linn.	Yellow Bunting.
E. aureola, Pall.	Yellow-breasted Bunting.
E. cirlus, Linn.	Cirl Bunting.
E. hortulana, Linn.	Ortolan Bunting.
E. rustica, Pall.	Rustic Bunting.
E. lesbia.	Lesbian Bunting.
E. cia, Linn.	Meadow-Bunting.
E. pithyornus, Pall.	Pine-Bunting.
E. cæsia, Cretz.	Cretzschmar's Bunting.
E. palustris, Savi.	Marsh-Bunting.
E. schœniculus, Linn.	Reed-Bunting.
Pyrgita domestica, Cuv.	Common Sparrow.
P. montana, Cuv.	Tree-Sparrow.
P. Hispaniolensis, Cuv.	Spanish Sparrow.
P. cisalpina, Cuv.	Alpine Sparrow.
P. petronia.	Doubtful Sparrow.
Fringilla cœlebs, Linn.	Chaffinch.
F. montifringilla, Linn.	Mountain or Bramble Finch.
F. nivalis, Linn.	Snow-Finch.
F. ? hyemalis.	Winter-Finch.
Linaria cannabina, Swains.	Common or Brown Linnet.
L. montana, Ray.	Mountain Linnet or Twite.
L. canescens.	Mealy Redpole.
L. minor, Ray.	Lesser Redpole.
Serinus flavescens.	Serin Finch.
Carduelis elegans, Steph.	Goldfinch.
C. spinus, Steph.	Siskin or Aberdevine.
C. citrinella.	Citril Finch.
Coccothraustes vulgaris, Briss.	Hawfinch.
C. chloris, Flem.	Green Grosbeak.
Loxia pityopsittacus, Bechst.	Parrot Crossbill.
L. curvirostra, Linn.	Common Crossbill.
L. leucoptera, Gmel.	White-winged Crossbill.
Corythus enucleator, Cuv.	Pine Grosbeak.
C. longicauda.	Siberian Grosbeak.
Erythrospiza erythrina, Bon.	Scarlet Grosbeak.
E. rosea.	Rosy Grosbeak.
E. githaginea.	Vinous Grosbeak.
Pyrrhula vulgaris, Temm.	Bullfinch.
Sturnus vulgaris, Linn.	Starling.
S. unicolor, Marm.	Sardinian Starling.
Pastor roseus, Temm.	Rose-coloured Pastor.
Nucifraga caryocatactes, Briss.	Nut-cracker.
Garrulus glandarius, Briss.	Jay.
G. infaustus, Temm.	Siberian Jay.
Pica caudata, Ray.	Magpie.
P. cyanea, Wagl.	Azure-winged Magpie.
Pyrrhocorax Pyrrhocorax, Temm.	Alpine Chough.
Fregilus graculus, Cuv.	Chough.
Corvus corax, Linn.	Raven.
C. corone, Linn.	Carrion Crow.
C. cornix, Linn.	Hooded Crow.
C. monedula, Linn.	Jackdaw.
C. frugilegus, Linn.	Rook.
Picus martius, Linn.	Great Black Woodpecker.
P. viridis, Linn.	Green Woodpecker.
P. canus, Gmel.	Gray-headed Green Woodpecker.
P. leuconotus, Bechst.	White-rumped Woodpecker.
P. major, Linn.	Great Spotted Woodpecker.
P. medius, Linn.	Middle Spotted Woodpecker.
P. minor, Linn.	Lesser Spotted Woodpecker.
Apternus tridactylus, Swains.	Three-toed Woodpecker.
Yunx torquilla, Linn.	Wryneck.
Sitta Europœa, Linn.	Common Nuthatch.
S. Syriaca, Ehrenb.	Dalmatian Nuthatch.
S. Asiatica, Temm.	Asiatic Nuthatch.
Certhia familiaris, Linn.	Common Creeper.
Upupa epops, Linn.	Hoopoe.
Tichodroma phœnicoptera, Temm.	Wall-Creeper.
Cuculus canorus, Linn.	Common Cuckoo.
C. glandarius, Linn.	Great Spotted Cuckoo.
Coccyzus Americanus, Vieill.	American Cuckoo.

ORDER III.—RASORES.

Columba palumbus, Linn.	Wood-Pigeon.
C. Œnas, Linn.	Stock-Dove.
C. livia, Linn.	Rock-Dove.
C. turtur, Linn.	Turtle-Dove.
Phasianus colchichus, Linn.	Common Pheasant.
Tetrao urogallus, Linn.	Capercailzie, or Cock of the Wood.
T. hybridus, Sparrm.	Hybrid Grouse.
T. tetrix, Linn.	Black Grouse.
Bonasia Europæa.	Hazel Grouse, or Gelinotte.
Lagopus Scoticus, Lath.	Red Grouse.
L. mutus, Leach.	Common Ptarmigan.
L. rupestris, Leach.	Rock Ptarmigan.
L. saliceti, Swains.	Willow Ptarmigan.
L. brachydactylus.	Short-toed Ptarmigan.
Pterocles arenarius, Temm.	Sand-Grouse.
P. setarius, Temm.	Pin-tailed Sand-Grouse.
Francolinus vulgaris, Briss.	European Francolin.
Perdix rubra, Ray.	Red-legged Partridge.
P. petrosa, Lath.	Barbary Partridge.
P. saxatilis, Meyer.	Greek Partridge.
P. cinerea, Lath.	Common Partridge.
Coturnix dactylisonans, Meyer.	Quail.
Hemipodius tachydromus, Temm.	Andalusian Turnix.
Glareola torquata, Briss.	Collared Pratincole.
Cursorius Isabellinus, Meyer.	Cream-coloured Courser.
Otis tarda, Linn.	Great Bustard.
O. houbara, Linn.	Ruffed Bustard.
O. tetrax.	Little Bustard.

ORDER IV.—GRALLATORES.

Grus cinerea, Bechst.	Common Crane.
G. leucogeranus, Temm.	White Crane.
Anthropoides virgo, Vieill.	Numidian Demoiselle.
Ardea cinerea, Lath.	Common Heron.

Birds of Europe.

Ardea purpurea, Linn.	Purple Heron.
A. comata, Pall.	Squacco Heron.
A. alba, Linn.	Great Egret.
A. garzetta, Linn.	Little Egret.
A. russata, Wagl.	Rufous-backed Egret.
Nycticorax Europæus, Steph.	Common Night-Heron.
Botaurus stellaris, Steph.	Common Bittern.
B. lentiginosus, Steph.	Freckled Bittern.
B. minutus, Selby.	Little Bittern.
Ciconia alba, Bellon.	White Stork.
C. nigra, Bellon.	Black Stork.
C. Maquari, Temm.	Maquari Stork.
Platalea leucorodia, Linn.	Spoonbill.
Phœnicopterus ruber, Linn.	Common Flamingo.
Œdicnemus crepitans, Temm.	Thick-kneed Bustard.
Himantopus melanopterus, Meyer.	Long-legged Plover.
Squatarola cinerea, Cuv.	Gray Plover.
Vanellus cristatus, Meyer.	Lapwing.
V. Keptuschka, Temm.	Keptuschka Lapwing.
Pluvianus spinosus.	Spur-winged Plover.
Charadrius pluvialis, Linn.	Golden Plover.
C. morinellus, Linn.	Dotterel.
C. hiaticula, Linn.	Ring-Dotterel.
C. minor, Meyer.	Little Ring-Dotterel.
C. Cantianus, Linn.	Kentish Plover.
C. pyrrhothorax, Temm.	Red-chested Dotterel.
Hæmatopus ostralegus, Linn.	Oyster-Catcher.
Ibis Falcinellus, Temm.	Glossy Ibis.
Numenius arquata, Lath.	Common Curlew.
N. Phæopus, Lath.	Whimbrel.
N. tenuirostris, Sav.	Slender-billed Curlew.
Limosa melanura, Leisl.	Black-tailed Godwit.
L. rufa, Briss.	Bar-tailed Godwit.
L. terek, Temm.	Terek Godwit.
Recurvirostra Avocetta, Linn.	Avocet.
Totanus fuscus, Leisl.	Spotted Redshank.
T. calidris, Bechst.	Redshank.
T. semipalmatus, Temm.	Semipalmated Sandpiper.
T. glottis, Bechst.	Greenshank.
T. Bartramius, Temm.	Bartram's Sandpiper.
T. stagnatilis, Bechst.	Marsh Sandpiper.
T. ochropus, Temm.	Green Sandpiper.
T. glareola, Temm.	Wood Sandpiper.
T. hypoleucus, Temm.	Common Sandpiper.
T. macularius, Temm.	Spotted Sandpiper.
Strepsilas collaris, Temm.	Turnstone.
Scolopax rusticola, Linn.	Woodcock.
S. major, Linn.	Great Snipe.
S. Sabini, Vig.	Sabine's Snipe.
S. gallinago, Linn.	Common Snipe.
S. gallinula, Linn.	Jack Snipe.
Macroramphus griseus, Leach.	Gray Snipe.
Calidris canutus, Briss. and Cuv.	Knot.
Machetes pugnax, Cuv.	Ruff.
Tringa rufescens, Vieill.	Buff-breasted Sandpiper.
T. pectoralis, Bonap.	Pectoral Sandpiper.
T. subarquata, Temm.	Pygmy Curlew.
T. variabilis, Meyer.	Dunlin or Purre.
T. Schinzii, Bonap.	Schinz's Sandpiper.
T. platyrhyncha, Temm.	Broad-billed Tringa.
T. minuta, Leisl.	Little Sandpiper.
T. Temminckii, Leisl.	Temminck's Tringa.
T. maritima, Brunn.	Purple Sandpiper.
Arenaria calidris, Meyer.	Sanderling.
Phalaropus hyperboreus, Lath.	Red-necked Phalarope.
Phalaropus platyrhynchus, Temm.	Gray Phalarope.
Fulica atra, Linn.	Coot.
Rallus aquaticus, Linn.	Water-Rail.
Porphyrio hyacinthinus, Tem.	Hyacinthine Porphyrio.
Gallinula crex, Lath.	Land-Rail.
G. chloropus, Lath.	Common Gallinule.
Zapornia porzana.	Spotted Crake.
Z. Baillonii, Leach.	Baillon's Crake.
Z. pusilla, Steph.	Little Crake.

ORDER V.—NATATORES.

Anser hyperboreus, Pall.	Snow-Goose.
A. ferus, Steph.	Gray-Lag Wild Goose.
A. segetum, Steph.	Bean Goose.
A. albifrons, Steph.	White-fronted Goose.
A. leucopsis, Bechst.	Bernicle Goose.
A. ruficollis, Pall.	Red-breasted Goose.
A. brenta, Flem.	Brent Goose.
Chenalopex Ægyptiaca, Steph.	Egyptian Goose.
Cygnus mansuetus, Gmel.	Domestic Swan.
C. ferus, Ray.	Whistling Swan or Hooper.
C. Bewickii, Yarr.	Bewick's Swan.
Tadorna vulpanser, Flem.	Common Shieldrake.
T. rutila, Steph.	Ruddy Shieldrake.
Mareca Penelope, Selby.	Wigeon.
Rhynchaspis clypeata, Steph.	Shoveller Duck.
Anas Boschas, Linn.	Common Wild Duck.
Querquedula Crecca, Steph.	Common Teal.
Q. glocitans, Vig.	Bimaculated Teal.
Q. circia, Steph.	Gargany Teal.
Dafila caudacuta, Leach.	Pin-tail Duck.
Chauliodes strepera, Swains.	Gadwall.
Fuligula ferina, Steph.	Red-headed Pochard.
F. leucophthalma, Steph.	White-eyed or Castaneous Duck.
F. rufina, Steph.	Red-crested Duck.
F. cristata, Steph.	Tufted Duck.
F. marila, Steph.	Scaup Pochard.
F. dispar, Steph.	Western Duck.
F. marmorata.	Marbled Duck.
Somateria mollissima, Leach.	Eider Duck.
S. spectabilis, Leach.	King Duck.
Oidemia perspicillata, Flem.	Surf Scoter.
O. fusca, Flem.	Velvet Scoter.
O. nigra, Flem.	Black Scoter.
Clangula vulgaris, Leach.	Golden Eye.
C. Barrovii, Sw. and Rich.	Barrow's Duck.
C. histrionica, Leach.	Harlequin Duck.
Harelda glacialis, Leach.	Long-tailed Duck.
Undina leucocephala.	White-headed Duck.
Mergus merganser, Linn.	Goosander.
M. serrator, Linn.	Red-breasted Merganser.
M. cucullatus, Linn.	Hooded Merganser.
M. albellus, Linn.	Smew.
Podiceps cristatus, Lath.	Great crested Grebe.
P. rubricollis, Lath.	Red-necked Grebe.
P. cornutus, Lath.	Horned Grebe.
P. auritus, Lath.	Eared Grebe.
P. minor, Lath.	Little Grebe, or Dabchick.
Colymbus glacialis, Linn.	Northern Diver.
C. arcticus, Linn.	Black-throated Diver.
C. septentrionalis, Linn.	Red-throated Diver.
Uria troile, Linn.	Foolish Guillemot.
U. lachrymans, Lapyl.	Bridled Guillemot.
U. Brunnichii, Sab.	Brunnick's Guillemot.
U. grylle, Lath.	Black Guillemot.
Alca impennis, Linn.	Great Auk.

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Alca torda, Linn.	Razor-billed Auk.
Mergulus alle, Bon.	Little Auk.
Mormon fratercula, Temm.	Puffin.
M. glacialis, Leach.	Northern Puffin.
Pelecanus onocrotalus, Linn.	Pelican.
P. crispus, Feld.	Dalmatian Pelican.
Phalacrocorax carbo, Steph.	Common Cormorant.
Ph. graculus, Briss.	Black Cormorant.
Ph. pygæmus, Steph.	Little Cormorant.
Ph. cristatus, Steph. and Flem.	Green Cormorant.
Ph. Desmarestii.	Desmarest's Cormorant.
Sula Bassana, Briss.	Solan Goose.
S. melanura, Temm.	Black-tailed Gannet.
Sterna Caspia, Pall.	Caspian Tern.
S. cantiaca, Gmel.	Sandwich Tern.
S. Anglica, Mont.	Gull-billed Tern.
S. hirundo, Linn.	Common Tern.
S. Dougallii, Mont.	Roseate Tern.
S. minuta, Linn.	Little Tern.
S. stolida.	Noddy Tern.
Viralva nigra, Leach.	Black Tern.
V. leucoptera, Leach.	White-winged Tern.
V. leucopareia, Steph.	Moustache Tern.
Xema ridibunda, Boié.	Laughing Gull.
X. atricilla.	Black-winged Gull.
X. melanocephala, Boié.	Black-headed Gull.
X. minuta, Boié.	Little Gull.
X. Sabinii, Leach.	Sabine's Gull.
Larus marinus, Linn.	Great black-backed Gull.
L. fuscus, Linn.	Lesser black-backed Gull.
L. glaucus, Brunn.	Glaucous Gull.
L. islandicus, Edm.	Iceland Gull.
L. argentatus, Brunn.	Herring Gull.
L. rissa, Linn.	Kittiwake Gull.
L. eburneus, Gmel.	Ivory Gull.
L. canus, Linn.	Common Gull.
L. Audouinii, Temm.	Audouin's Gull.
Lestris catarractes, Temm.	Skua.
L. pomarinus, Temm.	Pomarine Gull.
L. Richardsonii, Swains.	Richardson's Lestris.
L. parasiticus, Ill.	Parasitic Gull.
Puffinus Anglorum, Ray.	Manks Shearwater.
P. obscurus.	Dusky Shearwater.
P. cinereus, Steph.	Cinereous Shearwater.
Procellaria glacialis, Linn.	Fulmar Petrel.
Thalassidroma Leachii.	Fork-tailed Petrel.
Th. pelagica, Selby.	Common Storm-Petrel.
Th. ? Bulwerii.	Bulwer's Petrel.

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ORNITHOMANCY, a species of divination performed by means of birds, being the same with augury.

OROBIO, DON BALTHASAR, a celebrated Hebrew of Spain. He was carefully educated in Judaism by his parents, who were Jews, though they outwardly professed themselves Catholics; abstaining from the practice of their religion in every thing, except only the fast of expiation, in the month Tisis or September. Orobio studied the scholastic philosophy as taught in Spain, and became so skilled in it that he was appointed professor of metaphysics in the university of Salamanca. Afterwards, however, having applied himself to the study of physic, he practised with success that art at Seville, till, being accused of Judaism, he was thrown into the prison of the Inquisition, and suffered the most dreadful cruelties, in order to extort a confession. He tells us himself that he was put into a dark dungeon, so narrow that he could scarcely turn round in it; and he suffered so many hardships that his brain began to be disturbed. He talked to himself often in this way: "Am I indeed that Don Balthasar Orobio, who walked freely about in Seville, who was entirely at ease, and who had the blessings of a wife and children?" Sometimes he supposed that his past life had been but a dream, that the dungeon where he then lay was his true birthplace, and that it would to all appearance prove also the place of his death. At other times, as he had a very metaphysical head, he first formed arguments, and then resolved them; thus at once performing the different parts of opponent, respondent, and moderator. In this whimsical way he amused himself from time to time, and constantly denied that he was a Jew. After having appeared twice or thrice before the Inquisitors, his treatment was varied. At the bottom of a subterranean vault, lighted by two or three small torches, he was brought before two persons, one of them judge of the Inquisition, and the other secretary, who, having asked him whether he would confess the truth, protested, that in case of a criminal denial, the Holy Office would not be deemed the cause of his death, if he should expire under the torments, but that it must be imputed entirely to his own obstinacy. The executioner then stripped off his clothes, tied his feet and hands with a strong cord, and set him upon a little stool, whilst he passed the cord through some iron buckles which were fixed in the wall; after which, the stool having been drawn away, he remained hanging by the cord, which the executioner still drew tighter and tighter, to make him confess, till a surgeon assured the court of examiners that he could not possibly bear more without expiring. These cords put him to exquisite torture, by cutting into the flesh, and making the blood burst from under his nails. As there was certainly danger that the cords would tear off his flesh, care was taken to gird him about the breast with bands, which, however, were drawn so very tight that he would have run the risk of being suffocated, if he had not held in his breath whilst the executioner put the bands round him; by which device his lungs had room enough to perform their functions. In the agony of his sufferings, he was told that this was but the beginning of his torments, and that he would better confess before they proceeded to extremities. Orobio added further, that in order to frighten him, the executioner, placing himself on a small ladder, frequently let it fall against the shin-bones of his legs, and the staves being sharp, created exquisite pain. At last, after a confinement of three years, the Inquisitors, finding themselves baffled by his perseverance in denying his religion, ordered his wounds to be cured, and discharged him. As soon as he had obtained his liberty, he resolved to quit the Spanish dominions; and, proceeding to France, he was made professor of physic at Toulouse. The theses which he prepared as candidate for this place treated of putrefaction; and he maintained them with a metaphysical subtlety which embarrassed all his competitors. He resided for some time in this city, still outwardly professing the Catholic religion; but at last, weary of dissembling, he repaired to Amsterdam, where he was circumcised, took the name of Isaac, and professed Judaism, still continuing, however, to practise physic, in which he was much esteemed. Upon the publication of Spinoza's work, he began to despise a system the falsehood of which he quickly discovered; and when Bredenburg's answer to it came to his hands, Orobio, being persuaded that the writer, in refuting Spinoza, had also admitted some principles which tended to atheism, took up his pen against both, and published a piece entitled *Certamen Philosophicum*. But the dispute in which he engaged with the celebrated Philip Limborch against the Christian religion made the greatest noise. In this he exerted the utmost force of his metaphysical genius, and conducted himself with great temper. The three papers which he wrote on the occasion were afterwards printed by his antagonist, in an account which he published of the controversy, under the title of *Amica Collatio cum Judæo*. Orobio died in the year 1687.

ORONTES, a river of Syria, which has its rise near a small hill at the foot of Mount Lebanon, to the north of Damascus, not far from the source of the Jordan. The two rivers flow in opposite directions; the latter southward to Lake Asphaltites, the former to the north, till, near Antioch, it makes a circuit to the west and south, and falls into the sea. The waters of the Orontes, at their source, are said to issue out in a large stream from the solid rock. It then takes a bend eastward, receiving several smaller streams in its course, till at last it winds along to the north-east, through the plains of Khoms and Khamah, about a hundred miles from its source. It soon increases to a considerable size, and swells out suddenly into a large lake, extending at least five miles to the north-east, and in some places nearly two miles wide. It is contracted in some parts between narrow and steep banks; and its course is deep and rapid, being scarcely less than four miles an hour. Its waters are a dull yellowish white, from the clayey and chalky soil of its banks in the lake above. At Antioch, where it falls into the sea, it is stated by Buckingham to be from 100 to 150 feet wide, and its stream flows at the rate of about three miles an hour. Such is the parched nature of the climate, that it would be often dry were it not for the bars of sand which obstruct its course, and allow the water to accumulate. Its stream is very deeply sunk amongst rocks, and it can only be rendered subservient to the purposes of irrigation by being laboriously raised with wheels. It forms three lakes, the Bahr-el-Kades, that of Famie or Apamea, and that of Antioch. By means of this river and the Euphrates, it is thought that a shorter route to India, nearly navigable all the way, might be effected; and an expedition was sent out by the British government in 1835, under Colonel Chesney, to explore the navigation of the Euphrates for this purpose.

OROPESA, a town of Bolivia, in South America, in the department of Cochabamba. The district in which it is situated is so well irrigated by rivers and streams, that it yields immense harvests of grain and other agricultural products. Oropesa, formerly the capital, and still a considerable place, is situated in a beautiful and fertile valley, on the borders of a small stream, one of the tributaries of the Rio Grande. The chief occupation of its inhabitants consists in supplying the neighbouring provinces with fruits and grain. The climate is mild and salubrious. Oropesa stands in long. 67. 6. west, and lat. 18. 15. south. This is likewise the name of a small town of Cuzco, in Peru.

OROTAVA, a town of Teneriffe, one of the Canary Islands, in the North Atlantic Ocean. It is situated on a very steep declivity, and, from the great abundance of water which runs through the principal streets, it has a very pleasant appearance at a distance. The spring of Agua Mansa, collected into two large reservoirs, turns several mills, and is afterwards distributed amongst the vineyards of the adjacent hills. Orotava is the ancient Taoro of the Guanches. The houses are substantially built, but have a gloomy appearance; and the streets seem as if deserted. Near this town is the celebrated dragon-tree of Orotava, one of the most gigantic productions of the kind on the face of the globe. Its circumference near the roots is forty-five feet. Although Santa Cruz is the principal seaport, and the capital of Teneriffe, the riches and fertility of the island are to be found at Orotava; and here the wine is chiefly made, and also shipped when the weather allows.

ORPHEOREON, an instrument of the lute kind, and strung with eight wires. It is no longer used.

ORPHEUS, a celebrated poet and musician, who lived at such an early period that his history is involved in fable, and many doubt if we have any facts respecting him on which dependence can be placed. According to the common mythology, he was a native of Thrace, being born in a cave at Pimpleia, a city of Pieria, which was then included in Thrace (Schol. Apollon. i. 25; Strab. vii. 330, x. 471). He is said to have been son of Apollo, or of Œagrus, king of Thrace, and of the muse Calliope (Diodor. iii. 64). He was the brother of Linus (Apollodor. ii. 4, 9), and the pupil of Musæus (Clemens. Strom. i. p. 332), or his master (Syncel., p. 156; Paus. x. 7, 1; Suid.). He is placed by Eusebius eighty-five years before the fall of Troy. He visited Egypt, and was there initiated in all the learning of the priests. When he returned to Thrace, he instituted the mysteries of Bacchus, which, according to Herodotus (ii. 81), included opinions which were afterwards promulgated by Pythagoras. He studied also under the Dactyli Idæi of Crete (Diodor. v. 64), and was the friend and companion of Cadmus, the founder of Thebes. He took a distinguished part in the Argonautic expedition, and saved his companions from the fascination of the Sirens (Apollodor. i. 9, 25). On the death of his wife Eurydice, he is said to have visited the infernal regions, and, through the intercession of Proserpine, obtained permission from Pluto that Eurydice should return with him to earth, provided he would engage not to look on her till he reached the earth. He broke his promise, and Eurydice instantly disappeared (i. 3, 2). How and where he died is variously stated. Some say that he died of grief for the loss of Eurydice; others allege that he was killed by lightning, because he revealed to man what the gods intended should be concealed from them; or that he was torn to pieces by the Mænades of Thrace, for some disrepect shown to Bacchus. Olympus, Pangæus, and Hæmus, are all named as the place of his catastrophe. The poets indicated the sweetness of his music by feigning that it was capable of moving the very stones and trees. Lucian tells a story of the head and lyre of Orpheus being thrown by the Thracian women into the Hebrus, and, as it floated down, the head was heaved by the water on the lyre, and sent forth, as it glided along, doleful strains. The head and lyre having reached the island of Lesbos, the former was buried on the spot where the temple of Bacchus afterwards stood, and the lyre was long preserved in the temple of Apollo. According to Eratosthenes (*Catast.* 24), it was placed by Jupiter in the heavens, and formed the constellation called Lyra.

There can be no doubt that there was an early poet of this name, but Aristotle considered all the works which were circulated under his name as spurious (Cic. *De Nat. Deor.* i. 38); and Cicero ascribes them to Cercops, a Pythagorean, or to Onomacritus (Clemens. *l. c.*). The hymn to Jupiter, quoted by Stobæus (p. 40), is certainly very ancient, as it is alluded to by Aristotle (*De Mund. Op.* t. i. p. 475), and is not to be confounded with the productions of the later Platonic school, which we have under the title of the Orphic hymns. These hymns present a mixture of the theological ideas of the Greeks, Jews, and even Christians, so that there can be no doubt of the period in which they were written.

ORPIMENT (*auripigmentum*), a mineral composed of sulphur and arsenic, found native in the earth, and constituting one of the ores of arsenic, but sometimes artificially prepared.

ORRERY, a curious machine for representing the motions or phases of the heavenly bodies. The reason of its being called an Orrery was this: Mr Rowley, a mathematical-instrument maker, having got one from Mr George Graham, the original inventor, to be sent abroad with some of his own instruments, he copied it, and made the first for the Earl of Orrery. Sir Richard Steele, who knew nothing of Mr Graham's machines, thinking to do justice to the first encourager, as well as to the inventor of such a curious instrument, called it an Orrery, and gave Mr Rowley the praise which was due only to Mr Graham.

ORSKAIA, a town of Asiatic Russia, in the government of Orenburg, situated on the Or, about a mile and a half before its junction with the Oural. The Asiatic caravans usually pass this river here in their way to Orenburg. The town of Orenburg was originally built upon this spot. Orskaia is 132 miles east of Orenburg.

ORTEGAL, Cape, the most northern promontory of Spain, where there is also a castle of the same name. Long. 8. 20. W. Lat. 44. 0. N.

ORTELIUS, Abraham, a celebrated geographer, born at Antwerp in the year 1527. He was well skilled in languages and the mathematics, and acquired such reputation by his knowledge in geography, that he was surnamed the Ptolemy of his time. Justus Lipsius, and most of the great men of the sixteenth century, were the friends of Ortelius. He resided at Oxford in the reign of Edward VI. and came a second time into England in 1577. His *Theatrum Orbis* was the most complete work of the kind which had yet been published, and gained him a reputation equal to the immense labour bestowed in compiling it. He also wrote several other geographical works, the principal of which are his *Thesaurus*, and his *Synonyma Geographica.* The world is likewise indebted to him for the *Britannia,* which he persuaded Camden to undertake. He died at Antwerp in the year 1598.

ORTHEZ, an arrondissement of the department of the Lower Pyrenees, in France, 616 square miles in extent, containing seven cantons, 157 communes, and 83,600 inhabitants. The capital is the city of the same name, situated on the Gave de Pau. It contains 1000 houses, and 7300 inhabitants, who are occupied in making flannels and other woollen goods, and in tanning leather. A great quantity of hams are cured here, and sold under the name of Bayonne hams. It has been rendered remarkable by a victory which the Duke of Wellington gained there over the French army. Long. 0. 50. W. Lat. 43. 32. N.

ORTHODOX, in *Ecclesiastical History*, an appellation given to those who are sound in all the articles of the Christian faith.

ORTHOGRAPHIC Projection of the Sphere, that in which the eye is supposed to be at an infinite distance. It is so called, because the perpendiculars, from any point of the sphere, will all fall in the common intersection of the sphere with the plane of the projection.

ORTHOGRAPHY, that part of grammar which teaches the nature and affections of letters, and the just method of spelling or writing words, with all the proper and necessary letters. It forms one of the four great divisions or branches of grammar.

Orthography, in *Geometry*, the art of drawing or delineating the fore-right plan of any object, and of expressing the heights or elevations of each part. It is called *orthography*, from its determining things by perpendicular lines falling on the geometrical plane.

Orthography, in *Architecture*, is the elevation of a building or edifice.

Orthography, in *Perspective*, is the fore-right side of any plane, that is, the side or plane which lies parallel to a straight line, that may be imagined to pass through the outward convex points of the eyes, continued to a convenient length.

ORTHOPNŒA, a species or degree of asthma, where there is such a difficulty of respiration that the patient is obliged either to sit or stand upright in order to be able to breathe.

ORTHOSA, or Ortoso, a small seaport of Syria, in the pachalik of Tripoli, on the coast of the Mediterranean, about twelve miles north of Tripoli.

ORTIVE, in *Astronomy*, the same with eastern. The ortive or eastern amplitude, is an arch of the horizon intercepted between the place where a star rises, and the east point of the horizon, or point where the horizon and equator intersect.

ORTON, a market-town of the county of Westmoreland, in the east ward, 274 miles from London, and eight from Appleby. It has a market, which is held on Wednesday. Dr Burn, the author of the "Justice," and of some antiquarian local works, was long vicar of the parish church, a very large old building. The population in 1801 amounted to 1230, in 1811 to 1333, in 1821 to 1525, and in 1831 to 1501.

ORTONE a Mare, a city of Italy, on the sea-shore, in the province of Abbruzzo Citeriore, of the kingdom of Naples. It is situated near to Cape Aquabella, is surrounded with walls, is the see of a bishop, and contains 5680 inhabitants. It has no haven, but a good roadstead.

ORURO, the name of a department, and also of a province, of the republic of Bolivia, in South America. The department so called contains the three provinces of Paria, Oruro, and Caraugas. The whole district forms part of a very high table-land, perfectly level, and elevated more than 12,000 feet above the level of the sea. The province is bounded on the east by Cochabamba and Charcas; on the west by part of the great chain of the Andes, which separates it from Arequipa; on the north by La Paz; and on the south by Paria. That part of the Bolivian Andes in which Oruro is situated forms one of those metalliferous groups which are so common along the whole mountain chain. The silver mines here were formerly very rich and productive, but they are now nearly useless, being filled with water, which, in a country where machinery is little in use, proves an almost insurmountable barrier to mining operations. The city of Oruro stands in longitude 68. 17. W. and latitude 17. 58. S., at an elevation of 12,441 feet above the level of the sea. The climate, although cold, is by no means unhealthy; but, from the rarity of the atmosphere, some difficulty of breathing is at first experienced by those who are not accustomed to respire at such altitudes, and the alternations of heat and cold during a single day are exceedingly disagreeable to all. The city and province of Oruro were formerly populous, but since the unfortunate struggle for Peruvian independence under Tupac Amaru, which was put an end to in the year 1782, the aboriginal population in particular has very considerably declined. The province contains about 15,000, and the city between 4000 and 5000 inhabitants.

ORVIETO, a city of Italy, in the delegation Viterbo, in the papal dominions. It stands on a tuffstein rock, on the banks of the Paglia, and has a magnificent cathedral with some very fine paintings, a noble episcopal palace, with several other churches, and fourteen convents or monasteries for the professed of both sexes. It contains 7800 inhabitants, who are employed in the silk and other trades, and who produce excellent wine. Long. 12. 2. 26. E Lat. 42. 49. 24. N.

OSACCA, a large city of Japan, the port of Meaco. It is situated at the mouth of a considerable river, and at the head of a bay of the same name. It is the seat of an extensive trade, and one of the most flourishing cities of the empire. A quantity of earth is found in the neighbourhood, which is exported to all parts of Japan. It is twenty-five miles south-west of Meaco.

OSAGE, a large river of North America, and one of the affluents of the Missouri. (See the article Missouri.) This is also the name of a tribe of Indians who inhabit that part of the Missouri territory through which the river flows during the first part of its course. They likewise extend across the country to the Arkansas, and even to Red River, and are considered as a powerful tribe.

OSARA, or Asara, a village in the Syrian desert, near the Euphrates, 170 miles east-south-east of Aleppo.

OSCHA, a river of Asiatic Russia, which falls into the Irtysch, in the government of Tobolsk.

OSCHOPHORIA, a festival celebrated by the Athenians, and which receives its name ἀπο του φερειν τας ὀσχας, *from carrying boughs hung with grapes*, which were called ὀσχαι. The original institution is mentioned by Plutarch. Theseus, on returning from Crete, forgot to hang out the white sail, by which his father was to be apprized of his success. This neglect proved fatal to Ægeus, who threw himself into the sea, and perished. Theseus no sooner reached the land, than he sent a herald to inform his father of his safe return, and in the mean time he began to perform the sacrifices which he had vowed to make when he first set sail from Crete. The herald, on his entrance into the city, found the people in great agitation. Some lamented the king's death, whilst others, elated at the sudden news of the victory of Theseus, crowned the herald with garlands in token of their joy. The herald carried back the garlands on his staff to the sea-shore; and, after waiting until Theseus had finished his sacrifice, he related the melancholy account of the king's death; upon which the people ran in crowds to the city, showing their grief by cries and lamentations. From this circumstance, therefore, at the feast of Oschophoria, not the herald, but his staff, was crowned with garlands, and the people who were present exclaimed ἐλελευ, ἰου, ἰου, the first of which expresses haste, and the others consternation or depression of spirits. The same author further mentions, that Theseus, when he went to Crete, did not take with him the usual number of virgins, but that instead of two of them, he took youths of his own acquaintance, whom he caused to pass for women, by changing their dress, and accustoming them to the ointments and perfumes of women, as well as by a long and successful imitation of the female voice. The imposition succeeded. Their sex was not discovered in Crete; and when Theseus had triumphed over the Minotaur, he with these two young men led a procession with branches in their hands, and wearing the same habits, which were afterwards worn at the celebration of the festival. The branches they carried were in honour of Bacchus or Ariadne, or because they returned in autumn, when the grapes were ripe. Besides this procession, there was also a race, in which young men only whose parents were both alive had permission to engage. It was customary for them to run from the temple of Bacchus to that of Minerva, which was on the sea-shore. The place where they stopped was called ὀσχοφοριον, because the boughs which they carried in their hands were there deposited. The reward of the conqueror was a cup called πενταπλοα, *five-fold*, because it contained a mixture of five different ingredients, wine, honey, cheese, meal, and oil.

OSENOKA, a small river of Asiatic Russia, which falls into the Kolyma.

OSENEY ISLAND, in England, is formed by the river Isis, in the meadows near Oxford, where a magnificent abbey was erected at the instigation of a concubine of Henry I. to atone for her sins; and the same king built a palace there, in which Richard I. was born, and which Edward II. converted into a monastery.

OSILO, a city of the island of Sardinia, in the diocese of Tassari, in the northern division. It stands on the top of a mountain, in a very healthy situation, and contains 5430 inhabitants.

OSIMO, a city of Italy, in the delegation of Ancona, in the papal dominions. It is situated on an elevated and healthy situation, with most picturesque scenery around it. It is the see of a bishop, and has a cathedral and various other churches, as well as monastic establishments for both sexes, and is inhabited, besides, by several families of considerable wealth. There is a college and some learned societies, and a population of 11,750 persons, who subsist on their estates, or by agricultural labour.

OSIRIS, in *Mythology*, one of the gods of ancient Egypt, and by many believed to have been the Sun, or at least the mind actuating that luminary.

The Egyptians derived all things from two principles; one active, and the other passive. Their active principle, according to Jablonski, was an infinite and eternal Spirit; and their passive principle was Night. This spirit they considered sometimes as a male, sometimes as a female divinity, and occasionally they attributed to it both sexes; but it does not appear to have been the object of their worship. The earliest objects of Pagan adoration were the sun, moon, and planets; and that the philosophers and priests of ancient Egypt worshipped the Sun by the name of Osiris, may be proved by numberless testimonies from the most authentic records of antiquity. Diogenes Laertius affirms, that they held the Sun and Moon as divinities, and that they called the latter Isis; and Macrobius says expressly, "Nec in occulto est, neque aliud esse Osirin quam Solem, nec Isim aliud esse quam Terram." The same writer informs us, that in the hieroglyphical writings of ancient Egypt, "Osiris was represented by a sceptre and an eye," to denote that this god was the Sun looking down from heaven on all things upon earth. In the hieroglyphical inscriptions the symbol of Osiris is an eye surmounting a chair or throne.

It must not, however, be concealed, that some of the ancients, and a few of the most learned of the moderns, have contended, that by Osiris the Egyptians understood the Nile or spirit of the Nile, whilst others have confounded him with the Grecian Bacchus. Scaliger and Selden have adopted the former of these opinions, and Servius on Virgil has given countenance to the latter. But that they are all mistaken has been proved by Jablonski in such a manner as to enforce the fullest conviction. "When the Egyptians," says he, "in their sacred books, sometimes gave the name of Osiris to the Nile and its wonderful increase during the heat of summer, they meant nothing more than to attribute to their god Osiris the gift which fertilizes their country." This they would the more readily have done, because they believed the Nile to have its source in heaven. Hence Eusebius tells us, Οσιρις ἐστιν ὁ Νειλος, ὀν ἐξ ὀυρανου καταφερεσθαι διονται, *Osiris is the Nile, because they think it is sent down from heaven.* In one sense Osiris might be Bacchus, because the original Bacchus was himself the Sun; but that the Egyptian god could not be worshipped as the inventor of wine is undeniable, if, as Jablonski labours to prove, the primitive religion of that country inculcated upon its votaries that wine was the gift, not of a benevolent god, but of an evil genius, the enemy of the human race. In support of this opinion he quotes from Plutarch a passage, whence it appears, that, before the era of Psammetichus, the Egyptians neither drank wine themselves, nor offered it in libations to the gods; because they believed that the first vine which sprung from the earth was impregnated by the blood of those giants who perished in the war with the gods. It is indeed true, that the Greeks, who borrowed their religion as well as the first principles of their science from Egypt, attributed to Bacchus many of the actions of Osiris; but it is likewise true, that they ascribed to him other attributes, which the Egyptian god could not possess, consistently with the established superstitions of that country. Salmasius, however, attempts to prove, from the import of the name, that the Osiris of Egypt must have been the Bacchus of Greece. Σηρ, or Σιρι, he says, signifies *a son* in the Egyptian language; and hence he concludes that the god was called Osiris by the Egyptians, for the same reason that by the Greeks he was called Κουρος, and by the Romans *Liber*. But this seems to be all a mistake. *Siris* forms a part of many Egyptian proper names, as *Bu-siris*, *Thermo-siris*, *Tapo-siris*, and the like, and is by some derived from the Hebrew word *Sar*, *Sur*, or *Sir*, which signifies a prince, potentate, or grandee. As the name of the god was in Egypt not Osiris, but *Isiris*, or *Ysiris*, it was probably composed of *Sir* or *Siris*, and the Hebrew prefix *I* or *ish*, denoting strength; so that the whole word would signify the strong or mighty prince. And if so, we cannot doubt, as Diodorus Siculus, Eusebius, Sextus Empiricus, and others affirm, that the Egyptians worshipped the Sun by the name of Osiris, but that by this name they meant the power or governing mind of the Sun, as the Greeks and Romans seem to have done by their Phœbus and Apollo.

But although the original Osiris was undoubtedly the Sun, or the intelligence actuating the Sun, yet there is reason to believe that there was a secondary Osiris, who at a very early period reigned in Egypt, and was deified after his death, for the benefits which he had rendered to his country. This is indeed so generally admitted, that amongst the learned great controversies have arisen respecting the time when he flourished, and whether he was the civilizer of rude barbarians or the victorious sovereign of a polished nation. Newton, it is well known, has adopted the latter opinion, and with much plausibility endeavoured to prove that Osiris was the same with Sesostris or Sesak; but it must be confessed that his conclusion is contrary to all the most authentic records of antiquity, and that it would be easy, by the same mode of arguing, to give a show of identity to two persons universally known to have flourished in very distant ages. The annals of Egypt, as may be seen in the writings of Herodotus, Diodorus Siculus, Strabo, Plutarch, and others, who copied from them, expressly asserted the distinct personality of Osiris and Sesostris, and placed them in eras very distant from each other. If any credit be due to the historians just named, Osiris was the founder of the Egyptian monarchy; and, as was customary in those days, the same personage, having either received the name of the Sun, or communicated his own to that luminary, was after his death deified for the benefits which he had rendered to his country; and, being at first worshipped only as a demigod, was in process of time advanced to full divinity, and confounded with his heavenly godfather. The Greeks, who, although original in nothing, were always prompted by their vanity to hold themselves out as the first of the nations, claimed this Osiris as their own, and pretended that he was the son of Jupiter and Niobe. According to them, he reigned over the Argives; but afterwards, having delivered his kingdom to his brother Aigialeus, took a voyage into Egypt, of which he made himself master, and there married Io or Isis. He established many good laws in that country, and both Osiris and Isis were after their deaths worshipped as gods. But that this is a ridiculous fiction needs no proof; because every one knows that good laws were established in Egypt long before the Argives had any king, or indeed existed either as a tribe or a nation.

OSKOL-STAROI, a city of Russia, in the government of Kursk, the capital of a circle of the same name. It stands at the mouth of the river Oskolka, and has eight churches, a nunnery, 813 houses, and 6000 inhabitants, amongst whom many are occupied in the iron trade. It is 904 miles from St Petersburg. Long. 37. 29. E. Lat. 51. 15. N.

OSMANJIC, a town of Asiatic Turkey, in the government of Sivas, 140 miles north-west of Sivas.

OSMANSKOI, a small town of Asiatic Russia, in the government of Kolivan, on the Irtysch, 201 miles west-south-west of Kolivan.

OSNABRUCK, or OSNABURG, a province of the kingdom of Hanover. It has been formed out of the ancient sequestered bishopric of that name, which by the treaty of Westphalia had been fixed to be held in sovereignty alternately by a Catholic and a Protestant prince; and in consequence it came under the government of the late Duke of York, second son of George III. To the bishopric has been added by cession the Prussian bailiwick of Beckenburg, the lower county of Lingen, and the circles of Meppen and Emsbuhren. It is bounded on the north by East Friesland, on the north-east by Oldenburg and Diepholz, on the south-east and south-west by the Prussian province of Westphalia, and on the west by Bentheim. It extends over 1288 square miles, contains twenty towns and cities, 382 villages, with 249,470 inhabitants, of whom two thirds are Catholics, and the other third Protestants, chiefly of the Lutheran confession. It is generally a level and sandy district, excepting on the southern part, where there are two ranges of hills. Near these the soil is tolerably fertile; but on the other parts, except near the rivers, it is very poor and unproductive. The heaths are extensive, and a large portion of the province is covered with woods. The corn produced, even with the aid of extensive cultivation of potatoes, is not sufficient for the consumption. Flax is grown largely, and the spinning of it was the chief employment of the country people of both sexes during their long winters; but that occupation has been much diminished by the introduction of spinning by machinery in the countries which used to obtain their yarn from this province. Numerous bodies of the agricultural labourers repair to Holland to work, and some after harvest return home to live upon their earnings; but many of them remain to perform the lowest kinds of labour in Amsterdam, Rotterdam, and other cities, and many also enlist into the Dutch army. The province is formed into four divisions or circles, viz. Osnabruck, Lingen, Meppen, and Emsbuhren.

Osnabruck as it is called by the Germans, or Osnaburg as it is spelt by us, is the capital of the province. It is situated on the river Hase, is imperfectly fortified, and consists chiefly of one very long and not ill-built street, divided into the old and the new town. It is the see of a Catholic bishop, who has a palace and a cathedral; and there is a fine old council-house, in which the treaty of Westphalia was negotiated. It has two Catholic monasteries, a Lutheran gymnasium, two Lutheran churches, and one, besides the cathedral, for the Catholics. It contains about 1400 houses, and 10,500 inhabitants, who depend chiefly on the decaying linen trade, and on internal commerce. Long. 7. 33. 40. E. Lat. 52. 16. 45. N.

OSORIUS, JEROME, a Portuguese ecclesiastic, was descended of a noble family, and born at Lisbon in the year 1500. He was educated at the University of Salamanca, and afterwards studied at Paris and Bologna. On his return to Portugal he gradually rose till he obtained the bishopric of Sylves, to which he was appointed by Catharine of Austria, regent of the kingdom in the minority of Dom Sebastian. At the request of Cardinal Henry of Portugal, he wrote his history of King Emanuel, and the expedition of Gama, which his great contemporary Camoens made the subject of his Lusiad. It is remarkable that the history of Osorius and the epic poem of Camoens were published in the same year, 1572. But the fate of these two great authors was very different. The poet was suffered to perish in poverty, under the reign of that same Henry who patronised the historian; yet, allowing for the difference of their professions, they possessed a certain similarity of mind. Even in the priest Osorius there appear many traces of that high and heroic spirit which animated the soldier Camoens, particularly in the pleasure with which he seems to describe the martial manners of his countrymen under the reign of Emanuel. "In that age," says he, "poverty and sadness were banished from Portugal. Complaints were never heard; but every place, from the court to the cottage, resounded with mirth and music. Illicit love was unknown; nor would the ladies listen to the most honourable addresses of such youths as had not signalized themselves in war. No young man about court, however noble by birth, was permitted to wear the dress of manhood till he had passed over into Africa, and thence brought back with him some animal esteemed for its rarity; and such was the hardy education of the nobility in that age, that many of them travelled everywhere in quest of adventures." This is a striking picture of the manners of chivalry, to which Portugal owed much of its glory in that splendid period. There is one particular in the character of Osorius, which, considering his age and country, deserves the highest encomium; and that is his tolerant spirit. In the first book of his history he speaks of Emanuel's cruel persecution of the Jews in the following generous and exalted language: "This," says he, "was authorized neither by law nor by religion. Can men be compelled to believe what they reject with abhorrence? Do you take upon you to restrain the liberty of the will, or to fetter the understanding? Such an attempt must be unsuccessful; and is not acceptable to Christ, who expects from man devotion of the heart, and not that formal worship which is the offspring of pains and penalties. He wishes them to study his religion, and accept it from conviction, not from terror; for who does not see that forced belief is mere hypocrisy?" Osorius is said to have used many arguments to dissuade Dom Sebastian from undertaking his unfortunate expedition into Africa, and to have felt so deeply the miseries which befell the Portuguese after that fatal event, that his grief was supposed to have accelerated his death. He died in the year 1580, happy, says De Thou, who celebrates him as a model of Christian virtue, that he died just before the Spanish army entered Portugal, and thus escaped being a witness to the desolation of his country. His various works were published at Rome in 1592, by his nephew Osorius, in four volumes folio, with a life of their author. Amongst these there are two remarkable productions; the first, an Admonition to Queen Elizabeth, exhorting her to return into the bosom of the Church of Rome; and the second, an Essay on Glory, written with such classical purity, as to give birth to a report that it was not the composition of Osorius, but the last work of Cicero on that subject.

OSSA, a lofty mountain of Thessaly, near the Peneus, which runs between this mountain and Olympus; it was famous in the fabulous story of the giants.

OSSA, a town of the island of Gilolo, situated on the southern side of a great bay of the same name. It affords water, provisions, timber for spars, and other necessary ar-

D'Ossat. ticles, with which ships touching at the island are supplied. Long. 128. 22. E. Lat. 0. 45. S.

OSSAT, Arnaud d', a celebrated cardinal, and one of the most remarkable men of his time, was born at Laroque-en-Magnoac, a village in the diocese of Auch, in the year 1536. In the strictest sense of the Spanish expression, he was "the son of his own works." There is reason to believe that his father, who died in distress in Spain, exercised the profession of farrier; and this opinion is in accordance with the common tradition, according to which D'Ossat was ushered into the world by an army-farrier. At the age of nine, he found himself without any known parents, and having no other resource than public charity. But a gentleman of the neighbourhood, named De Marca, received the orphan into his house, and caused him to be educated along with one of his nephews, who had been committed to his care. In this situation the progress of D'Ossat was so striking, that in a very few years he was thought capable of acting as preceptor to the companion of his studies. In 1559 he received orders to attend his pupil, and two other nephews of M. de Marca, to Paris; and he was likewise intrusted with the charge of a son of a merchant in Lectoure, who accompanied them. To these youths he devoted the utmost care and attention till the year 1562, when, having completed their course of study, they returned to their relations; thus relieving him from those extrinsic duties, the performance of which had impeded his own progress, and prevented him from increasing at pleasure the amount of his own acquirements. During this period, however, he had studied rhetoric and philosophy, and, in particular, had profited by the lessons of Ramus, whose bold and penetrating mind had enabled him to strike into new paths of inquiry. Hence, when Charpentier, the fierce champion of Aristotle, attacked Ramus, D'Ossat defended the doctrine of his master in a judicious production, entitled *Expositio in Disputationem Jacobi Carpenterii de Methodo*, Paris, 1564, in 8vo, the elegant and close dialectics of which so disconcerted Charpentier, that the only answer he could make to his adversary consisted in scurrility and abuse. D'Ossat quitted Ramus to study the civil law under Cujas in the university of Bourges. His intention was to qualify himself for the profession of advocate; and accordingly, having taken his diploma, he returned to Paris in the year 1568, and was admitted to the bar. But being as yet almost unknown, and without the means necessary to enable him to wait for employment in the ordinary course of the profession, he had not long attended the sittings of the parliament of Paris ere he became convinced that he would never find his place amidst so much that was arbitrary on the bench, and the barbarism that reigned at the bar. Fortunately for him, however, the celebrated Paul de Foix then filled the office of counsellor to the parliament. The merit of D'Ossat could not escape the notice of a magistrate who cherished so strong a passion for letters. De Foix, notwithstanding his enthusiasm for Aristotle, and his favour for Charpentier, sought out the modest advocate, admitted him to the learned society which met at his house, and having seen cause to esteem him more and more in proportion as he became acquainted with him, procured for D'Ossat the situation of counsellor to the presidial, or local court, of Melun; an office which appears to have imposed on him little or no duty, since he continued to hold it as late as the year 1588. D'Ossat having in this way become necessary to his patron, accompanied him into Italy in the year 1574. A political mission of pure etiquette had been confided to De Foix, and he accordingly considered his journey merely as an opportunity thrown in his way of adding to his literary enjoyments. Whilst he travelled on horseback, D'Ossat explained to him Plato, whilst De Thou read the *Paratitla* of Cujas; and all the three, like worthy friends of Montaigne, sometimes discoursed together on the peripatetic philosophy. The orthodoxy of De Foix having been called in question by the pope, and his holiness having ordered "an information" on the conduct which he had pursued in the parliament, D'Ossat composed an apologetical memoir in behalf of his friend. But this defence produced no other result than making its author advantageously known.

De Foix withdrew from Rome, in order to allow the proceeding which had been commenced against him to fall asleep. D'Ossat, however, remained; and it was probably during this interval that he took holy orders. In 1581, De Foix returned to Rome as ambassador of Henry III., and chose D'Ossat as his secretary. This choice was, in every respect, fortunate; and so completely did the secretary enter into the views of his principal as to the manner of conducting business, that the resemblance observable in the style of their despatches has induced an erroneous belief that these were all prepared by D'Ossat. After the death of De Foix, D'Ossat was employed in the same capacity by Cardinal Hippolyte d'Este, official protector of the church of France, whose entire confidence he had gained; and he acquired a still greater ascendency over Cardinal de Joyeuse, who succeeded Cardinal d'Este. After the disgrace of Villeroi, Henry III. offered the place of that minister to D'Ossat; but he refused to succeed a man who had strong claims on his gratitude. Besides, he foresaw that, in this elevated post, it would be impossible for him to make head against the intrigues of the Guises; and he loved his country too well to render himself subservient to their ambition. His experience prevented him from being seduced, like so many others, by the pretexts of the League; he maintained a courageous fidelity to his sovereign; and he wrote, in the name of Cardinal de Joyeuse, a letter approving of the murder of the Guises. Joyeuse afterwards allowed himself to be drawn into the ranks of the Leaguers; but he repaired his error by a noble devotion, which no subsequent act belied, to Henry IV. D'Ossat being charged by the queen-dowager, the widow of Henry III., to solicit the celebration of the obsequies of that unfortunate prince, vainly endeavoured, during several years, to overcome the resistance of the pope, who refused his assent to a ceremony which had been consecrated by usage. Whilst he was thus interceding for the memory of Henry III., De Thou dedicated to him a poem he had written on the death of that royal victim. D'Ossat, though without any public character, and without orders from the French ministry, zealously interposed to effect the reconciliation of Henry IV. with the holy see; and this prince being informed of his spontaneous exertions, as well as of his capacity, wrote to request him to put himself in communication, and act in concert, with the Duke of Nevers, who was then on his way to Rome, provided with full powers. The duke, however, despising an auxiliary calculated to prove the more useful as he was less conspicuous, undertook to conduct the negotiation alone, and completely failed. Nevertheless, Clement VIII. was exceedingly desirous that Henry should be solemnly admitted into the communion of the Catholic Church; but he wished, at the same time, to keep terms with Spain, and to obtain condi tions advantageous to the holy see.

Accordingly, he acted with an "innocent duplicity," which completely deceived the Spaniards. One of them, who held the office of chamberlain to the pope, having published a pamphlet in order to prove that a relapsed heretic could neither be absolved nor recognised as king, D'Ossat wrote a triumphant reply. Clement, however, although he approved of the substance of this production, required that it should only be circulated privately. D'Ossat entertained no doubt whatever as to the real intentions of the pope; but in the negotiation, with which he was at length exclusively intrusted, he had constantly to guard against the captious and formalist character of the court of Rome. When he had smoothed all obstacles, Duperron was sent to Rome to join him in receiving the stipulated absolution in name of the king. The first condition which the pope wished to impose on the royal commissioners, was to deposit the crown of France at the feet of the pontifical throne. But the representatives of Henry declared firmly that they would never consent to any proposition inconsistent with the independence of the royal authority; nor did they show themselves less decidedly opposed to every clause which had a tendency to compromise anew the tranquillity of the state, or excite alarm amongst the Huguenots. The Spanish faction murmured at not being able to prevent an absolution, which conciliated to Henry the opinion of a great number of his subjects. But their discontent was unavailing. Everything had been satisfactorily arranged, and Duperron was appointed to the bishopric of Evreux; whilst D'Ossat, who had brought about this happy result, received as his recompense the title of councillor of state, and the bishopric of Rennes.

During the remainder of his life he actively co-operated in all the diplomatic affairs which were conducted in Italy. By his means the connection which had subsisted nearly thirty years between Margaret of Valois and Henry IV. was dissolved. The dispensation granted by the pope, to validate the union of Catherine of Bourbon and the Duke de Bar, was also his work. He took part in the negotiation concerning the restitution of the marquisate of Saluces; observed the astute conduct of the Duke of Savoy; induced the Grand Duke of Tuscany to evacuate the forts which he occupied in the isles of If and Pomègue near Marseilles; proved, in a memoir which he distributed to the sacred college, that the peace recently concluded at Vervins was more necessary to Spain than to France; and was chosen to announce that peace to the senate of Venice. In satisfying Clement VIII. respecting the delay of publication experienced by the Council of Trent, the guarantees which the edict of Nantes granted to the Protestants, and the rigorous measures ordained against the Jesuits, D'Ossat displayed all the resources of an insinuating mind, and dissipated the clouds formed by the Spanish influence at the court of Rome. His experience appears to have been only once at fault, in a case where he took counsel of his affections rather than of his judgment. We allude to the assent which he gave to a project of the pope for placing upon the throne of England the Duke or Cardinal of Parma, to the prejudice of the son of Mary Stuart.

D'Ossat, by his simple and modest character, no less than by his prudence, his private virtues, and his talents, had procured for himself many friends, and reached the highest consideration he could attain in the face of the double obstacle of poverty and obscurity of birth, when, in the year 1599, he received a cardinal's hat, which was conferred on him at the earnest solicitation of the king. The following year he was appointed to the bishopric of Baïeux, which, however, he almost immediately found means to resign with advantage. Nevertheless, his last years were embittered by vexation, and saddened by disappointment. To support his dignity, he had only two benefices, the revenues of which were in part seized on by the neighbouring gentlemen. The king had granted him a pension sufficient for a man accustomed to limit his personal wants; but it was not regularly paid. Sully, who hated, in the person of D'Ossat, the protégé of Villeroi, hesitated not, first to suspend, and then altogether to discontinue, the annual prestation to which the bounty of his sovereign had given him a title; and the cardinal would have been exposed to all the pangs of shame and misery, if the heirs of Hippolyte d'Este had not paid to him a legacy of L.500, which had been exigible for more than ten years. Besides, D'Ossat, who only saw the internal situation of France with the eyes of Villeroi, formed an exaggerated notion of some disorders produced by the rigorous administration of Sully; and, under this impression, wrote to the king a letter, in which he drew a dark picture of the dangers with which he believed the state to be threatened. Sully, more irritated than ever, was loud in his complaints against the cardinal; and in his *Mémoires* may be found the imputations which he laid to the charge of a man who, like himself, had devoted all his thoughts to the service of his sovereign. D'Ossat, however, had the consolation of learning that he retained the esteem of Henry IV., if he had lost the favour of his great minister. He died on the 13th of March 1604, in the sixty-eighth year of his age; and as he had no known relations, he divided his little property between his two secretaries and the poor.

Madame d'Arconville published a prolix Life of Cardinal d'Ossat, Paris, 1771, in two vols. 8vo, in which she inserted a translation of a remarkable memoir on the effects of the League, composed in Italian by D'Ossat, and containing an able exposition of the character of the policy pursued by the Guises, with the consequences which might be expected to result from it. The Letters published under the name of Cardinal Joyeuse may also be regarded as the productions of D'Ossat; but it is to the collection of his own Letters addressed to Villeroi that he is chiefly indebted for his classical reputation in diplomacy. Chesterfield recommended them to his son as the work best calculated to give him an insight into the conduct of affairs; and Wicquefort appears to have had them continually in view in his treatise entitled *L'Ambassadeur*. The language of D'Ossat is natural and full of sincerity; his statements are marked by a grave and concise simplicity; he is almost never betrayed into any false step or unguarded expression; and he interests us equally by his modesty and his loyalty. Now, when the court of Rome is no longer the centre of negotiations, and the ideas of men have taken another course, his diplomatic correspondence has necessarily lost much of its importance; but with reference to the history of the time to which it refers, it must ever be consulted with advantage. As the collection of his Letters does not commence until the month of April 1593, it thus leaves a gap in his political life from the year 1589 until the period in question. The first edition was published at Paris in 1624, folio, by the brothers Dupuy; but it has been much surpassed by that of Amelot de la Houssaye, which appeared at the same place in 1697, in two vols. with notes, and which was reprinted with additional notes at Amsterdam, 1707, 1714, and 1732, in five vols. 12mo. This work was translated into Italian by Jerome Canini, and published at Venice, 1629, in 4to. (A.)

OSSERO, a town of the island of Cherso, in the Adriatic, within the Austrian province of Trieste. It stands on the western side of the island, on a promontory, and is the see of a bishop, but with only 360 houses and 1540 inhabitants. It is also the name of an island separated from Cherso by a narrow channel which is not passable by vessels. It is well cultivated, and very productive of wine. It contains two townships or communes, with 1600 houses and 7200 inhabitants.

OSSIAN, the son of Fingal, a celebrated Celtic bard, who is commonly supposed to have flourished about the end of the second or the beginning of the third century.

Several incidents in the poems ascribed to him are conceived to point out this as the era of the poet; particularly the engagement of Fingal with *Caracul*, "the son of the king of the world," who, according to Macpherson and Whitaker, is the same with the son of Severus, the *Caracalla* of Roman history. Fingal, who commanded the Caledonians at that memorable juncture, is said to have eluded the power of Severus, and gained a signal victory on the banks of the Carron, in which Caracul fled from his arms "along the fields of his pride." As Gibbon observes, however, "Something of a doubtful mist still hangs over these Highland traditions, nor can it be entirely dispelled by the most ingenious researches of modern criticism; but if we could with safety indulge the pleasing supposition that Fingal lived, and that Ossian sung, the striking contrast of the situation and manners of the contending nations might amuse a philosophic mind. The parallel," he adds, "would be little to the advantage of the more civilized people, if we compared the unrelenting revenge of Severus with the generous clemency of Fingal; the timid and brutal cruelty of Caracalla with the bravery, the tenderness, the elegant genius of Ossian; the mercenary chiefs who, from motives of fear or interest, served under the imperial standard, with the free-born warriors who started to arms at the voice of the king of Morven: if, in a word, we contemplated the untutored Caledonians, glowing with the warm virtues of nature, and the degenerate Romans, polluted with the mean vices of wealth and slavery."

Speculations like these, however, though they may amuse by their novelty, or surprise by a striking contrast of situation and of manners, can have no real value in themselves, if they rest merely on a "pleasing supposition," unsupported by evidence. "That Fingal lived, and that Ossian sung," can only be believed upon the assumption that the poems ascribed to the son of the Caledonian hero are authentic productions; and, until this be established, it is obviously vain to attempt to deduce from them any inference as to the existence of the one, the era of the other, or the circumstances and manners of the times when they are said to have flourished. The primary question therefore is, Are the poems attributed to Ossian, more especially those given to the world by Macpherson, the genuine productions of a Celtic bard of the third century; or are they, on the other hand, a forgery, palmed upon the world by an individual who attempted to give currency to his own compositions under the mask and pretence of a high antiquity?

"The appearance of the poems of Ossian," says the Abbate Cesarotti, "was a phenomenon so unexpected and extraordinary, that it is not surprising they should have excited doubts and astonishment, even during the period of enthusiasm itself, in a country scarcely known to history—wild, savage, and covered with mists; in a state of society the most rude, miserable, and barbarous, without commerce, without learning, without writing, and without arts; how could there arise so transcendent a genius, who should at length come to dispute the palm with the most celebrated poets of the most polished nations, nay, even with those who for so many ages were regarded as models of the art? This novelty was too much at variance with all received opinions to be believed without question, or admitted without controversy. Was there truly an Ossian? Was he really the author of the poems which have been published under his name? Can this be a spurious work? But when? How? By whom? These are the questions which have divided England and civilized Europe respecting this surprising phenomenon. These are the doubts which have been raised by learned men and critics; doubts which, though much weakened, have not yet been entirely removed from the minds of many persons. Whatever opinion be adopted, it is certain that various embarrassing difficulties present themselves, and that the most strenuous advocates on both sides cannot fail to waver in their conclusions."[1]

The ingenious Italian translator having here suggested the questions which it is most material to resolve, before any conclusion can be safely deduced from the contents of the poems themselves, we shall endeavour to furnish our readers with the means of judging for themselves respecting the whole matter in controversy; first, by submitting a short historical account of the manner in which the poems ascribed to Ossian are said to have been originally collected, translated, and published, by Macpherson; secondly, by exhibiting a summary of the arguments which have been employed to disprove the authenticity of these poems; thirdly, by stating the results of the elaborate inquiry into the nature and authenticity of the poems of Ossian, instituted by the Highland Society of Scotland, and conducted by a Committee of that body, under the auspices of its chairman, Mr Henry Mackenzie, by whom the Report was drawn up; and, lastly, by subjoining some particulars respecting the other collectors of Celtic poetry, whose proceedings form a curious sequel to those of Mr James Macpherson. It is only by a clear and comprehensive statement of the whole case, that a rational judgment can be formed respecting the various matters in dispute; nor is it possible otherwise to enable the reader to decide for himself, whether the doubts raised by learned men and critics have been removed, or even in any material degree obviated.

[1] L'apparizione delle poesie di Ossian era un fenomeno così impensato e straordinario, che non è da stupirsi se destò nel tempo stesso entusiasmo, sorpresa, e dubbi. In un paese appeno noto alla storia, alpestre, selvaggio, ingombro, e quasi oppresso di nebbia; in uno stato di società il più rozzo, meschino, e barbaro, senza commercio, senza idee, senza scrittura, senz'arti, come potea sorgere un Genio così trascendente, che venisse a disputar la palma ai poeti più celebri delli più colte nazioni; a quegli stessi, che si riguardano da tanti secoli come i modelli dell'arte? Questa novità rovesciava troppo tutte le idee ricevute per esser accolta senza contrasto. Vi fu veramente un Ossian? fu egli realmente l'autore delle poesie, che comparvero sotto il suo nome? Sarebbe questa un' opera supposta? ma quando? come? da chi?...Ecco le questioni, che per lungo tempo divisero l'Inghilterra, et l'Europa colta sopra questo sorprendente fenomeno. Ecco i dubbi, che insorsero nei letterati, e ne'critici; dubbi che quantunque indeboliti di molto, non sono però cessati interamente in tutti gli spiriti. Qualunque opinione si adotti, è certo, che l'una e l'altra presentano varie difficoltà imbarazzanti, e che possono far vacillare i più fermi sostenitori dei due partiti." (*Ragionamento Storico-Critico intorno le Controversie sull' Autenticità dei Poemi di Ossian nell' Opere dell' Abbate Cesarotti*, vol. ii. p. 49, Firenze, 1807, in 12mo.)

An English translation of Cesarotti's Historical and Critical Dissertation was published by Dr John M'Arthur (London, 1806, in 8vo), "one of the Committee of the Highland Society of London, appointed to superintend the publication of Ossian in the original Gaelic." But, for the sake of the Celtic bard, it is to be hoped that this gentleman's knowledge of Italian cannot be taken as the measure of his acquaintance with Gaelic. We have been at the pains to compare his translation with the original, and the result has been to satisfy us that he was not only incapacitated, by ignorance of the language, for translating any Italian work correctly; but that he has, in several parts of the Historical and Critical Dissertation, been guilty of *material suppressions.* Examples of both occur in his translation of the passage above quoted. 1. The words of the original, "in uno stato di società il più rozzo, meschino, e barbaro, senza commercio, senza idee, *senza scrittura*, senz'arti," he renders, "in a state of society the most unpolished, wretched, and barbarous;" thus *suppressing* the material words, "senza scrittura," *without writing*, containing an important admission on the part of the Italian translator of Ossian. 2. His knowledge of the original may be judged of from his translation of the following sentence: "Ecco le questioni, che per lungo tempo divisero l'Inghilterra, e l'Europa colta sopra questo sorprendente fenomeno," which he renders thus: "These are questions that for a length of time have *agitated* and divided *public opinion in* England, *while* Europe *regarded with veneration* this surprising phenomenon." This is either ignorance, or something still worse. Cesarotti says nothing about "Europe *regarding with veneration*," &c.: what he states is, that the questions he had indicated long divided England, *and* civilized Europe, respecting the unexpected and extraordinary appearance of the poems of Ossian. Numerous instances of a similar and still more striking kind might easily be added.

I. The first person who seems to have conceived the idea of collecting and translating some of the traditional poems floating in the Highlands, was a young man named Jerome Stone, formerly a schoolmaster at Dunkeld. In 1756, he published, in the Scots Magazine, a translation in verse of *Bas Fhroich*, or the death of Fraoch, under the title of Albin and Mey; and this specimen he accompanied with a short letter addressed to the editor, indicating his opinion of the poetical merits of the various pieces in his possession. Stone did not think of giving to the public the original of his translation; but Mr Mackenzie, having procured it from Mr Chalmers of London, into whose hands it had accidentally fallen, has inserted it in the appendix to the Report of the Committee of the Highland Society, with Stone's version and a literal translation subjoined. This poem, according to Dr Graham, approaches nearer to the style of the Gaelic fragments of Ossian than any thing he had yet met with.[1] About the same time Mr Pope, minister of Reay, in Caithness, had thoughts of making a collection of the old Highland poems ascribed to Ossian, in concert with a gentleman then living on Lord Reay's estate; but the death of the latter, upon whose assistance he had mainly depended, put an end to the scheme.[2]

The next, and by far the most celebrated, collector of Gaelic poetry, was Mr James Macpherson, whose translations first attracted notice to the supposed productions of the Celtic muse, and whose proceedings in connection with these gave rise to the controversy which so long divided the literary world. The circumstances which originally led to the employment of this gentleman as a collector and translator of Gaelic poetry, have been fully stated by Mr Mackenzie, in the Report of the Committee of the Highland Society.

Mr Home, author of Douglas, happening to be at Moffat, a watering-place in Dumfriesshire, in the summer of 1759, met there with Macpherson, whom he found officiating as tutor to Mr Graham, younger of Balgowan, whose father's family was then residing at that place. In the course of his inquiries about the manners and customs of the Highlanders, Mr Home learned from Macpherson, that one of their favourite amusements consisted in listening to the compositions of their ancient bards, which were described as highly pathetic and imaginative; and some fragments of these traditional poems, which, at Mr Home's desire, Macpherson translated from memory, struck him as exceedingly beautiful. Mr Home communicated these pieces to his friends, whose opinion proved as favourable as his own; and, under this impression, they prevailed on Macpherson to publish them in a small volume at Edinburgh, at the same time undertaking to superintend the publication, and also to defray the expense. To this volume Dr Blair wrote an introduction; and, on its appearance, it attracted "universal attention." The literary circle of Edinburgh, consisting of David Hume, Dr Robertson, Dr Blair, Dr Carlyle, Mr Home, and others, felt much interested in the discovery of what seemed to be a new mine of poetical wealth; and a subscription was accordingly entered into to enable Macpherson to make a tour through the Highlands for the purpose of collecting larger and more complete poems, which he represented as still existing there, and of which some of the pieces already published were described by him as only detached and disconnected fragments. He particularly mentioned a poem in an epic form, and of considerable length, on the subject of the wars of Fion or Fingal, which he thought might be recovered entire. Mean while, that is, about 1758, he published, in his own name, a poem, entitled *The Highlander*, which appears to have sunk into oblivion immediately after its publication; but the remembrance of this production was revived by Mr Laing, in the controversy which subsequently arose respecting the authenticity of the poems ascribed to Ossian; and it is not a little remarkable that the style and imagery of the poem called Fingal occur in almost every page of The Highlander.

Under the patronage of the eminent individuals already mentioned, Macpherson performed his literary tour in 1766; transmitting from time to time accounts of his progress, and of the various poems which, as he said, he had succeeded in collecting. The districts through which he travelled were chiefly the north-western parts of Inverness-shire, the Isle of Skye, and some of the adjoining islands; places which, from their remoteness, and the state of manners that then existed in them, were thought the most likely to afford, in a pure and genuine state, those traditionary tales and poems in the recital of which the Highlanders were represented as taking so much delight. On his return from the north, Macpherson passed some time with an early acquaintance of his own, Mr Gallie, then a missionary in Badenoch; and availed himself of the assistance of this gentleman, as well as of that of Mr Macpherson of Strathmashie, in collating the different copies of the poems which he had collected, in translating difficult passages, and in determining the meaning of obsolete words.[3] He then proceeded to Edinburgh, where he communicated to his patrons the result of his expedition, and in 1762 published *Fingal*, an epic poem in six books, with some other detached pieces of a similar kind. In an advertisement prefixed to Fingal, he states, that "some men of genius had advised him to print the originals by subscription, rather than deposit them in a public library;" and, in the preliminary dissertation, he says that "his translation is literal, and that as he claims no merit on account of his version, he wishes that the imperfect semblance which he draws may not prejudice the world against an original which contains what is beautiful in simplicity, or grand in the sublime." In the year 1765, he published another epic poem, entitled *Temora*, to the seventh book of which he annexed the original Gaelic; but of all the rest he published only translations. At his death, however, he left a sum of money for defraying the expense of publishing the originals of the whole, with directions to his executors for carrying that purpose into effect. But, from whatever cause, this publication has not yet appeared, and it is more than probable that it never will.[4]

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[1] Essay on the Authenticity of Ossian's Poems, p. 208, et seq.

[2] Appendix to the Report on Ossian, No. 3.

[3] It is alleged that Macpherson, when he undertook his journey to the Highlands, was but an indifferent proficient in the Gaelic language. An instance of this, to which much importance seems to be attached, is recorded in the Appendix to the Committee's Report (p. 95); and a Highland gentleman who met him in London in 1762 also describes him as being "very imperfectly acquainted with the Gaelic language." The instance mentioned in the Report, however, amounts only to a verbal blunder in conversation, and is so very trifling, that we are surprised to find it gravely adduced as a proof of Macpherson's ignorance of Gaelic; whilst as to the opinion expressed by the Highland gentleman who met Macpherson in London, the measure of its value must be the competency of that individual to form a correct judgment, a subject on which we have no information. The object of impeaching Macpherson's knowledge of Gaelic is to render it improbable that he could have fabricated the originals of the poems which he professed to have translated. But it is forgotten that Gaelic was his mother tongue; and that, though his knowledge of that language might not be great, he could command the assistance of others who were more skilful than himself.

[4] All the information that the Committee of the Highland Society could collect on this subject is contained in the following passage of their Report (p. 79, et seq.):—"A source of information to which your Committee early applied was the executors of Mr Macpherson, of whom they requested to know if he had left behind him any of those MSS., particularly those ancient books which the Committee understood he possessed. Mr John Mackenzie, of the Temple, London, whom Mr Macpherson had left sole trustee

public access to his manuscripts, at one time proposing to print them by subscription, and at another to deposit them in some public library; and, lastly, they have not yet been published, and probably never will, because, if they were, their authenticity would be fully as liable to challenge or dispute as the translations which Macpherson professed to have made from them. The demand made by Dr Johnson and others was in itself most reasonable; and the refusal to produce evidence, merely because men doubted in a case where there was great room for incredulity, is either a proof that none whatever existed, or an instance of perversity unexampled in the history of literary controversy.[1]

II. But if Blair, in his elaborate and rhetorical Dissertation, had done little or nothing to remove the doubts which from the first were entertained as to the authenticity of the poems ascribed to Ossian, incredulity gained still greater confidence from the formidable and systematic onset of Mr Laing. In the third volume of his History of Scotland, that gentleman, in treating of the Highlanders, had adverted to the state of society and manners represented in these poems, as existing amongst that people, about the end of the second or commencement of the third century, and had thence deduced an argument against the authenticity of productions displaying a refinement and cultivation of sentiment inconsistent with all history and experience. "The productions of the Celtic muse," said he, "would persuade us to believe that the early manners of the Highlanders displayed a civilization inconsistent with an utter ignorance of the arts of life; an uniform heroism unknown to barbarians; a gallantry which chivalry never inspired; a humanity which refinement has never equalled; and that before their advance to the shepherd state, they possessed a correct taste, a polished diction, a cultivated and sublime poetry, enriched with the choicest images of classical antiquity, and intermixed with all the sentimental affectation of the present times. Their history contains no marks of primeval refinement, unless we can persuade ourselves that their descendants, as soon as they approached observation, degenerated on emerging from the savage state, and became more barbarous in proportion as they became more civilized."

The improbability of such an inversion of the ordinary law of human society is sufficiently apparent. But Mr Laing, not content with urging this argument, which he held to be "unanswerable," annexed to the fourth volume of his history a "Dissertation on the supposed Authenticity of Ossian's Poems," in which he has reduced his numerous detections, historical and critical, under a few general heads, "and endeavoured," as he says, "to disabuse his countrymen, and to put an end, if possible, to the controversy and deception for ever." These heads are, the Roman History of Britain, the Middle Ages, Tradition, the Customs and Manners of the Times, the Real Origin of the Poems, Imitations of the ancient and modern Poets, the pretended Originals, and Macpherson's avowal of the whole imposture; thus embracing the whole question in all its bearings and details. In such an article as the present, it is of course impossible to enter into a subject branching out into so many divisions; or even to attempt giving an abstract of the various arguments which have been urged by Mr Laing in attempting to disprove the authenticity of the poems ascribed to Ossian. We shall therefore content ourselves with indicating a few of the leading points, leaving those who take an interest in the controversy, or desire further information, to consult the Dissertation itself.

On the first branch of his subject, Mr Laing contends that, as the Highlanders originated from Ireland, and as their arrival from that country is established by the concurrence of every Scottish and Irish historian, whether their first migration is placed in 258 under Cairbar Riada, or postponed until 503, when they were restored by Fergus MacErth and his brother Loarn, there was not a Highlander in Scotland of the present race at the beginning of the era which is assigned to Fingal by Macpherson. He next shows, that by connecting his poems with Roman history, Macpherson has fallen into the most ridiculous mistakes. Gibbon had previously remarked the absurdity of making the Highland bard describe the son of Severus "by a nickname invented four years afterwards, scarcely used by the Romans till after the death of that emperor, and seldom employed by the most ancient historians;"[2] and the detection is as complete with respect to Carausius, who is represented as the contemporary and successor of that emperor. The most noted or classical places in Scotland are also, by a dexterous anticipation, appropriated to Ossian, as Carron, Glencoen or Cona, and Dumbarton the Alcuith of Bede. The name of Balclutha Mr Laing considers as fictitious; and in Fingal's intercourse with other nations he discovers the same minute yet conclusive anachronisms. The invasions from Lochlin, a name unknown until the ninth century, are also, according to Mr Laing, equally fabulous with the pretended exploits of Fingal against the Romans. The detections resulting from a comparison of the incidents mentioned in these poems with the history of the middle ages are not less important. They relate chiefly to Magnus, surnamed Barefoot; Cathula or Ketil, the friend of Fingal; Carrick-Thura, the palace of the king of Innistore; and the circle of Loda.

But one of the strongest points of Mr Laing's argument is that which has for its object to disprove that poems of such length could have been preserved entire, for upwards of fifteen hundred years, by means of oral tradition alone. "It is indeed strange," says Hume, in a letter to Gibbon, "that any man of sense could have imagined it possible, that above twenty thousand verses, along with numberless historical facts, could have been preserved by oral tradition, during fifty generations, by the rudest, perhaps, of all the civilized nations, the most necessitous, the most turbulent, and the most unsettled. Where a suppo-

[1] "I suppose my opinion of the poems of Ossian," says Johnson, "is already discovered. I believe they never existed in any other form than that which we have seen. The editor or author never could show the original, nor can it be shown by any other: to revenge reasonable incredulity by refusing evidence, is a degree of insolence with which the world is not yet acquainted; and stubborn audacity is the last refuge of guilt. It would be easy to show it if he had it; but whence could it be had? It is too long to be remembered, and the language formerly had nothing written. He has doubtless inserted names that circulate in popular stories, and may have translated some wandering ballads, if any can be found; and the names and some of the images being recollected, make an inaccurate auditor imagine that he has formerly heard the whole." (*Journey to the Western Islands*, pp. 273, 274, London, 1774.) Bishop Warburton expresses a similar opinion. "Several fragments in these poems have been heard by living witnesses, sung to the harp both in the Highlands and in Ireland. My solution of the difficulty is, that on these and from these fragments the forgery has been erected." "You will say," he adds, "it is a work infinitely above one of those *tame cheaters* we call a sophist. I do not know how it is, but mimicry is a species of poetic imitation so different from the true, that we have seen excellent copies in painting from originals of great masters, by those whose own designs were all sign-post daubings. The most celebrated mimics on the stage, as Eastcourt and Foote, were the most miserable actors; and, to come a little nearer, the book written by Burke against civil society, under the name and character of Bolingbroke, is far superior to any other of his compositions." (*Extract of a Letter to Mr Mason*, dated 12th January 1762.)

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sition is so contrary to common sense, any positive evidence of it ought never to be regarded. Men run with great avidity to give their evidence in favour of what flatters their passions and their national prejudices." The consideration of the mutability of language also supplies an argument which cannot easily be obviated. This is counteracted only by letters and by the art of printing; but an unwritten language naturally diverges into different dialects, and in every age assumes a new form, although the radical structure may remain. If these poems, then, are alleged to have been preserved by oral tradition, in an obsolete diction, that is, in a dialect disused by the people, this alone is sufficient to confute their authenticity. But if it be maintained that the language has remained invariably the same since the end of the second or beginning of the third century, this is contrary to the experience of all nations, and, besides, is disproved by the difference of the Gaelic from the parent Irish, a page of which a few centuries old is confessedly unintelligible to the people of the present day. Nor has the difficulty been in any degree removed by the numerous attestations which have, at different times, been obtained. No sooner were the translations published, than the traditionary existence of the poems disappeared. When Dr Johnson visited the Western Isles, the natives had nothing to communicate that deserved attention; and his assertion that there was not a Gaelic manuscript above a century old still remains undisproved by the publication of any such document. In proof that the Highlanders were neither rude and illiterate, nor the Gaelic an unwritten language, in the time of Ossian, it has been alleged that the Druids, when expelled from Scotland, retired to Iona, where they established a college, and lived and taught unmolested till the sixth century, when they were dispossessed by St Columba. But, according to Mr Laing, there is no evidence, nothing indeed but conjecture, that the Druids ever existed in Ireland; and the fact appears to be certain, that there never was a Druid in Scotland, otherwise Tacitus, who describes the destruction of their order in England, would most probably have remarked their influence or existence under Galgacus in the Caledonian war. "The man," he adds, "who can thus create an historical fact, requires nothing but genius to fabricate an epic poem." Finally, if manuscripts be appealed to, "let a single book of Fingal in manuscript, such as translated by Macpherson, of an older date than a century, be produced and lodged in a public library, and there is an end of the dispute."

Mr Laing then proceeds to show that the contradiction is not greater between the primeval refinement ascribed to the Highlanders, and their recent barbarism, than between their real manners at the period of Fingal and those described in the poems of Ossian. He alleges that religion was avoided as a dangerous topic, which led to detection; that, from the difficulty of inventing a religious mythology, Macpherson has created a savage society of refined atheists, who believe in ghosts, but not in deities; and that, solicitous only for proper machinery, he has rendered the Highlanders a race of unparalleled infidels, who believed in no gods but the ghosts of their fathers. And the same difficulty, he adds, occurred in the adaptation of circumstances, peculiar customs, or rites, to the supposed state of society; points on which Macpherson has laid himself open to suspicion or detection. Mr Laing next traces the origin of the poems ascribed to Ossian, which he ascribed to the failure of Macpherson's avowed poem, entitled The Highlander, published at Edinburgh in 1758, four years before the appearance of Fingal, and a desire on the part of Macpherson to insure a more favourable reception to his subsequent productions, by assigning to them a remote antiquity.[1] He shows, that when The Highlander is examined, its plot exhibits the very outlines of Fingal; that the inferiority of The Highlander to Fingal affords no presumption whatsoever that the latter is authentic; and that the Fragments of Gaelic Poetry published at Edinburgh in 1760, were produced when his taste and style had been considerably improved. But the most copious and curious source of detection is, according to Mr Laing, the constant imitation of the classics, the Scriptures, and such temporary publications as were then in vogue. The details on this part of the subject admit not of any condensation, and the reader is consequently referred to the Dissertation itself. Some of the supposed imitations are perhaps a little overstrained, and others not very obvious or striking; but the number that is liable to neither objection is so great, and in many cases so apparent, as to be altogether destructive of the notion that Macpherson translated from originals which had been composed by a Celtic bard, who flourished fifteen centuries before the time when his pretended compositions were given to the public. As to the specimens of the original produced by Macpherson, Mr Laing contends that they were translated into Gaelic from the *English original* by the translator himself; and, in particular, that the original Gaelic of Malvina's Dream was produced by the translator at the request of Lord Kames. Lastly, he has shown that, from the very beginning, Macpherson avowed the deceit, and that he ended, as we have already seen, by expressly vindicating and appropriating to himself the poems which he had at first attributed to Ossian.

Dr Graham's Essay on the Authenticity of the Poems of Ossian professes to be an answer to Mr Laing's masterly Dissertation on the same subject. But in reality it is only a piece of captious controversial writing, deficient in critical ability, displaying neither originality, acuteness, nor research, and as devoid of candour and fairness[2] as it is

[1] What says Mr Macpherson himself in his preface to Fingal? "Poetry, like virtue, receives its reward *after death*. The fame which men pursued in vain, when living, is often bestowed upon them when they are not sensible of it. This neglect of *living authors* is not altogether to be attributed to that reluctance which men show *in praising and rewarding genius*. It often appears that the man *who writes* differs from the *same man* in common life. His foibles, however, are obliterated by death, and his better part, *his writings*, remain: his character is formed from them; and he that was *no extraordinary man* in his own time, becomes the *wonder of succeeding ages*. From this source proceeds our veneration for the dead. Their virtues remain, but the vices which were once blended with their virtues have died with themselves. *This consideration might induce a man, diffident of his abilities, to ascribe his own compositions to a person whose remote antiquity, and whose situation when alive, might well answer for faults which would be inexcusable in a writer of this age.*"

[2] Dr Graham, in the Introduction to his Essay, has taken occasion to remark, "that though the Committee of the Highland Society of Scotland has, *very properly, considered it as* BENEATH ITS DIGNITY to STOOP *to the refutation of the arguments of Mr Laing*, it may not be improper for one who has little to lose, and who may have the good fortune to gain some advantage in the discussion, to enter the lists even with this powerful antagonist." It would have been more creditable to Dr Graham, however, if he had not prefaced his entry into the lists, as he calls it, by a most unpardonable misrepresentation. In the Report of the Committee, there is not one word from which it can, by any violence of construction, be inferred that they were guilty of the ridiculous folly and presumption here ascribed to them. They very properly "wished sedulously to avoid anything like controversy, desirous rather of procuring *evidence* and *information*, than of *drawing inferences* from them;" and, so far from their Report embodying any expression which could justify the strange assertion that they "considered it as beneath their dignity to *stoop* to the refutation of Mr Laing's arguments," which was no part of the plan upon which they proceeded, it contains abundant proofs of the respect and deference which they showed for the views and opinions of that distinguished person. Compare with this disingenuous allegation, the honest valedictory appeal of the ac-

public access to his manuscripts, at one time proposing to print them by subscription, and at another to deposit them in some public library; and, lastly, they have not yet been published, and probably never will, because, if they were, their authenticity would be fully as liable to challenge or dispute as the translations which Macpherson professed to have made from them. The demand made by Dr Johnson and others was in itself most reasonable; and the refusal to produce evidence, merely because men doubted in a case where there was great room for incredulity, is either a proof that none whatever existed, or an instance of perversity unexampled in the history of literary controversy.[1]

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Dr Graham's Essay on the Authenticity of the Poems of Ossian professes to be an answer to Mr Laing's masterly Dissertation on the same subject. But in reality it is only a piece of captious controversial writing, deficient in critical ability, displaying neither originality, acuteness, nor research, and as devoid of candour and fairness[2] as it is

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[1] What says Mr Macpherson himself in his preface to Fingal? "Poetry, like virtue, receives its reward *after death*. The fame which men pursued in vain, when living, is often bestowed upon them when they are not sensible of it. This neglect of *living authors* is not altogether to be attributed to that reluctance which men show *in praising and rewarding genius*. It often appears that the man *who writes* differs from the *same man* in common life. His foibles, however, are obliterated by death, and his better part, *his writings*, remain: his character is formed from them; and he that was *no extraordinary man* in his own time, becomes the *wonder of succeeding ages*. From this source proceeds our veneration for the dead. Their virtues remain, but the vices which were once blended with their virtues have died with themselves. *This consideration might induce a man, diffident of his abilities, to ascribe his own compositions to a person whose remote antiquity, and whose situation when alive, might well answer for faults which would be inexcusable in a writer of this age.*"

[2] Dr Graham, in the Introduction to his Essay, has taken occasion to remark, "that though the Committee of the Highland Society of Scotland has, *very properly, considered it as* BENEATH ITS DIGNITY to STOOP *to the refutation of the arguments of Mr Laing*, it may not be improper for one who has little to lose, and who may have the good fortune to gain some advantage in the discussion, to enter the lists even with this powerful antagonist." It would have been more creditable to Dr Graham, however, if he had not prefaced his entry into the lists, as he calls it, by a most unpardonable misrepresentation. In the Report of the Committee, there is not one word from which it can, by any violence of construction, be inferred that they were guilty of the ridiculous folly and presumption here ascribed to them. They very properly "wished sedulously to avoid anything like controversy, desirous rather of procuring *evidence* and *information*, than of *drawing inferences* from them;" and, so far from their Report embodying any expression which could justify the strange assertion that they "considered it as beneath their dignity to *stoop* to the refutation of Mr Laing's arguments," which was no part of the plan upon which they proceeded, it contains abundant proofs of the respect and deference which they showed for the views and opinions of that distinguished person. Compare with this disingenuous allegation, the honest valedictory appeal of the ac-

of ingenuity or talent. At the outset, Dr Graham seems disposed to throw James Macpherson overboard. "I speak only of the poems," says he; "of Macpherson's dreams I make no account." But, unfortunately, the one can never be separated from the other. The question is not as to the existence of detached poems, songs, or "wandering ballads," which nobody has disputed; but whether it is possible now to produce the originals of Fingal, Temora, and other poems, of which Mr Macpherson has given what he calls translations, and at the same time to establish the authenticity of these originals. Until this be done, or until some ancient manuscript of these poems shall have been published, all the arguments employed by Mr Laing will remain in full force and unshaken. It is no doubt true that Dr Blair has pronounced Ossian superior to Virgil, and that the Italian translator, Cesarotti, who implicitly adopted his opinion, has re-echoed the same extraordinary sentiment. This, however, is matter of taste alone; and as Dr Blair's Dissertation left the real question at issue exactly where the ingenious author found it, the same thing may, without any discourtesy, be affirmed of Dr Graham's Essay. The attempts made, in the latter work, to answer Mr Laing's arguments in detail, have signally failed in the object contemplated, particularly in all questions of a purely historical kind. In proof of this we need only refer to his confused notions respecting the origin of the Caledonians; the absurdities in which he has involved himself from not understanding the statements of Bede, upon which he professes to ground part of his refutation of Laing; and especially the extraordinary notion, contradicted by all history, that Ireland derived its Celtic population from Scotland. In grasping at straws, he also betrays a consciousness of the weakness of his cause, or the difficulty of the side which he has undertaken to defend. It may be true, as he alleges, and as several persons have testified, that Macpherson was not at first very profoundly skilled in the Gaelic language; but it is to be observed that this was his vernacular tongue, and that, at all events, he had the assistance of persons whose knowledge of the Highland dialect has never, as far as we know, been questioned or disputed.

But Dr Graham, when at a loss to resolve difficulties by an appeal to facts, has always a theory at hand to help him. The transmission of the poems of Ossian, by oral tradition, through a period of more than fifteen centuries, is acknowledged to be "a phenomenon of which we have no example in the history of literature." Yet we are desired to receive with undoubting faith this unparalleled anomaly; first, because, from the time in which these poems were composed till that in which "they were collected and translated by Macpherson, the Caledonians or Highlanders remained unconquered; and, secondly, because, in consequence of this permanency of political situation, their language remained unaltered, and unmixed with any foreign idiom." In this last point, however, Dr Graham contradicts himself, and makes an admission which appears of itself to be fatal to his theory. After informing his readers that the poems ascribed to Ossian "bear throughout the stamp of antiquity," he adds, "that *some foreign*, and *even some modern terms*, sometimes occur;" but that "still the Gaelic idiom is maintained, and the *purity* of its structure preserved inviolate." Nor is his reference to the supposed history of the poems of Homer, as a case in point respecting the alleged oral transmission of those ascribed to Ossian, much more fortunate than his theory of the immutable permanency and purity of the Gaelic language. For every scholar who has read Wolf's *Prolegomena ad Homerum* must be aware that this is neither more nor less than citing what is doubtful or improbable, in one case, to support what is at least equally doubtful or improbable in another. And as to the wonderfully retentive memory ascribed to the old Highlanders, it may be sufficient to observe, that this new theoretical element cannot be admitted upon a mere assumption without proof, and contrary to all experience or probability. Lastly, Dr Graham, anxious to dispose of the whole question at once, furnishes us with what he calls "a very obvious criterion of originality." "Mr James Macpherson," says he, "was brought up in the bosom of polished society; his mind was enriched with the stores of ancient and modern literature; he was familiarized, from an early period of life, to the modes of acting, and thinking, and expressing himself, which characterize the scholar of the present times. That a person of such education, and of such habits of thinking, should so completely divest himself of all his previous acquisitions in literature, and science, and of every idea rendered familiar to him by long use; and that he should be able to write with uniform consistency, in the character of a person who is supposed to have lived fourteen hundred years ago, and in a state of society so different from the present order of things; in short, that a modern European should produce such a work as the poetry of Ossian, distinguished exclusively by the ideas peculiar to people in the most simple state of society,—all these, I confess, I must consider as *efforts beyond the reach of humanity*." We are not prepared to admit that the real case is here fairly stated, or that Macpherson has preserved the uniform consistency which Dr Graham has gratuitously ascribed to him; indeed Mr Laing has shown that, in numerous cases, the very reverse is the fact. But supposing that the doctor were correct to the letter in his statement of the question, it follows that Chatterton achieved an "effort beyond the reach of humanity," by the composition of the poems he ascribed to Rowley, which are entirely divested of every allusion to the modes and manners of the time when they were written, whilst the language is almost as faultlessly antique as that of the era to which the ingenious and unfortunate author chose to assign them.[1]

III. We come now to the Report of the Committee of the Highland Society, which, as a sort of judicial document, is particularly deserving of attention. The Committee in question was appointed for the express purpose of collecting all the evidence and information which could be obtained on the subject; and with this view it began by circulating a set of queries, embracing the principal points which had been brought into dispute in the controversy respecting the authenticity of the poems ascribed to Ossian. Its declared object was sedulously to avoid all controversy on the subject, and rather to collect materials from which a judgment might be formed respecting the question at issue, than to attempt to pronounce any formal decision of its own. In this spirit the Report was drawn up by Mr Henry Mackenzie, the chairman; and although there is a manifest and not unnatural bias in favour of the Celtic bard, yet, upon the whole, it displays a candour, fairness, and impartiality which, on a subject where national prejudices had been strongly excited, cannot be too highly commended. It only remains for us, therefore, to lay before our readers the results of this patient and laborious investigation, as these have been stated in the Report itself, and to leave them to form their own judgment.

complished and enthusiastic author of the *Phingaleis:* "Jamque vale, mi Laingi: si fors resipueris; si te pœniteat; si reum tete confiteare, fas tibi mecum in amicitiam coire. Solemne namque fuit adeoque est Caledonibus,

Parcere subjectis, et debellare superbos."

[1] The *Gil Blas* of Le Sage is another instance in point. Though written by a Frenchman, it is, in sentiment, feeling, manners, and habits of thought and expression, as completely *Spanish*, as if it had been the production of Cervantes himself.

Before proceeding, however, to submit to the Society the general conclusions at which they had arrived, the Committee felt themselves called upon to take notice "of some difficulties in this investigation, which have struck, and must strike, every impartial person at all acquainted with the subject, and conversant at the same time with the history of nations, and the progress of society." 1. The first of these is the circumstance of the language, in poems for which such a high antiquity is claimed, being so nearly what it still is, in the common use and understanding of the country. This has always been considered as a fatal objection; and, as we have already seen, it is forcibly urged by Mr Laing, who contends, that if the language had been ancient or obsolete, the poems could not have been preserved, and that the circumstance of its being modern is a proof that the poems could not be ancient. The Committee, however, suggest that "perhaps the situation of the Highlands and Islands, where this poetry has been preserved, and the little communication they had with other countries, may *in some measure* account for this circumstance." 2. Another preliminary difficulty adverted to is, that any human memory should have been able to retain poems of such length, and so numerous, as some of those Highlanders, from whose oral recitation the collectors of such poems professed to obtain them, are said to have repeated. The solution offered by the Committee is the common one, that "the power of memory in persons accustomed from their infancy to such repetitions, and who are unable to assist or injure it by writing, must not be judged of by any ideas or any experience possessed by those who have only seen its exertions in ordinary life;" and that "instances of such miraculous powers of memory" are known in most countries, "where the want of writing, like the want of a sense, gives an almost supernatural force to those by which that privation is supplied." 3. A third difficulty, which has always appeared to intelligent inquirers the hardest to be surmounted in this matter, is the style of manners and of sentiment exhibited in the poems ascribed to Ossian. The Committee reply, that in all the ancient Celtic poetry, a distinction is made between the Fingalian race and their invaders or enemies, the former assuming a degree of generosity, compassion, and delicate attention to the female sex, which is denied to the latter; and, besides, that some allowance ought to be made "for the colouring of poetry on the manners and sentiments of the heroic persons of whom it speaks." The real difficulty, however, is to explain how any poet living amidst barbarism, violence, and anarchy, could have conceived or imagined a style of manners and sentiment so different from all that he could ever have known or observed, and drawn such pictures of generosity, compassion, and gallantry, as are to be found in the poems of Ossian.

Having disposed of these preliminary difficulties, the Committee proceed to report, that there are two questions to which it has directed its attention, and on which it now submits the best evidence it has been able to procure. These are, 1st, What poetry, of what kind, and of what degree of excellence, existed anciently in the Highlands of Scotland, and was generally known by the denomination of *Ossianic*, from the universal belief that its father and principal composer was Ossian the son of Fingal? And, 2d, How far that collection of such poetry published by Mr James Macpherson is genuine?

In answer to the first of these questions, the Committee states with confidence an opinion "that such poetry did exist; that it was common, general, and in great abundance; that it was of a most impressive and striking sort, in a high degree eloquent, tender, and sublime." The second question, however, the Committee found it "much more difficult to answer decisively." It was possessed of no documents to show how much of his collection Mr Macpherson had obtained in the form in which he gave it to the world. The poems and fragments of poems they had been able to procure contained often the substance, and sometimes almost the literal expression, of *passages* given by Mr Macpherson in the poems of which he published translations. "But the Committee has not been able to obtain *any one poem the same in title and tenor* with the poems published by him. It is inclined to believe that *he was in use to supply chasms, and to give connection by inserting passages which he did not find, and to add what he conceived to be dignity and delicacy to the original, by striking out passages, by softening incidents, by refining the language*, in short, by *changing* what he considered as too simple or too rude for a modern ear, and *elevating* what in his opinion was below the standard of good poetry. To what degree, however, he exercised these *liberties*, it is impossible for the Committee to determine." Such is the deliberate judgment pronounced in the report; a judgment, we may observe, which disposes of the whole matter in dispute, by establishing the important fact, that there could exist no originals, in the proper sense of the term, from which Macpherson's *translations*, manufactured as they are here admitted to have been, could possibly have been derived. That he availed himself largely of the traditionary poems and ballads which formerly circulated in the Highlands, as in most other countries similarly situated, no one has ever denied or disputed. This, indeed, has been the opinion even of those who most strenuously contended that his pretended translations, taken as a whole, were spurious. But that there ever existed in the Gaelic language such long and connected poems as those of *Fingal* and *Temora*, seems to be now definitively decided in the negative. The Report concludes by stating, that the Committee "encountered many more difficulties, and was obliged to bestow more labour, than it was at all aware of when it undertook the investigation committed to it by the Society;" and it adds, that this labour "has, after all, *effected its purpose in a very imperfect manner*;" meaning, no doubt, in as far as regards the object originally contemplated, of establishing the authenticity of the poems ascribed to Ossian. In this "purpose," indeed, if such was entertained, it has entirely failed; but, on the other hand, it evinced perfect candour and impartiality in its researches, and acted throughout with a jealousy and circumspection which it rightly conceived to be due to itself, to the Society, and to truth.

IV. In order to render our view of this subject as complete as possible, it only remains to notice two other collectors of Gaelic poetry; namely, Mr Duncan Kennedy, and Dr Smith of Campbelton.

Mr Kennedy, originally a schoolmaster in Argyleshire, and afterwards an accountant in Glasgow, appears to have begun to collect Gaelic poetry somewhat prior to the year 1780; and his collection, consisting of three thin folio volumes in manuscript, having been purchased by the Highland Society of Scotland, is now in the possession of that body. Dr Graham, the author of the Essay already mentioned, having opened a correspondence with Mr Kennedy, called his particular attention to a passage in one of Dr Smith's letters to Mr Henry Mackenzie, in which the reverend gentleman states, that, on observing the beauty of one or two passages of some poems communicated to him by Kennedy, the latter said, *these were of his own composition*; and after stating to Kennedy how much it concerned his honour to take notice of this charge, Dr Graham invited him "to come forward, and make a fair acknowledgment of the share which he had in the business." Kennedy, nothing loth, obeyed the call thus made on him; and in his answer to Dr Graham's application, dated the 25th of October 1805, there is the following extraordinary, and, we may add, instructive passage: "As the rage of both parties must soon subside, a fair division of property ought to take place, and poetical justice [to be] distributed between Ossian and the fabricators. It will, therefore, be admitted, at least by me, that Macpherson *has interpolated*; that Smith *has composed*; and that Kennedy, with much reluctance, *is forced to confess, that he has ventured to make some verses*, which, perhaps his vanity may deceive him, but he is inclined to think, *approach nearest to the genuine strains of Ossian that have yet been produced in the Gaelic language*." In the same communication he declares that he composed about a sixth or seventh part of what is contained in the manuscripts purchased by the Highland Society; that the Death of Carril is entirely his own; that most of Bas Ossian he also claims; that considerable portions of the Death of Diarmid, Goll, Oscair, Garbh, Latha na Lìur, and other poems in the collection, are of his composition; and that "a good Gaelic scholar, of a good ear, and well acquainted with his imagery, and the qualifications and names of his favourite heroes and professed enemies, *may compose verses approximate to the excellence of the original, and which not one in a thousand will be able to distinguish from the real*" strains of Ossian. Here is a full, free, and instructive confession, which, although it excited the indignation and provoked the criticism of Dr Graham, who, no doubt, expected something very different, appears, nevertheless, to be distinguished for its frankness and candour, and which affords a significant hint of that process of manufacture which was pursued by Macpherson in concocting his pretended translations.

The next, and only other, collector we have to notice is the Rev. Dr John Smith of Campbelton, who, like Kennedy, performs a secondary part in this extraordinary literary imposture. It appears that Dr Smith had the use of Kennedy's manuscripts, and that he transcribed from them into his own collection whatever he conceived to possess merit. In the year 1780, Dr Smith gave this collection to the public in a translation; and, seven years afterwards, he published the *originals*, in an octavo volume, under the title of *Scandana*. Kennedy, however, in his letter to Dr Graham, distinctly states that Dr Smith "*composed*," or, in other words, fabricated originals; and as he has frankly acknowledged the share which he had in the fabrication of his own collection, the charge would carry considerable weight, even if it were not indirectly admitted by Dr Smith himself, which, as we shall presently see, is the case. Dr Graham, who appears to have been most unfortunate in the sources to which he applied for corroborative evidence, addressed a letter to Dr Smith, dated the 24th of March 1806, stating to him the confessions of Kennedy, including the charge of fabrication against Smith himself, and requesting that he would point out the manner in which he might be effectually vindicated from so disgraceful an imputation. Dr Smith, however, being less sensitive on this point than his correspondent, took the matter very calmly, and abandoned all his publications to their fate with the most stoical indifference. "On the subject of your letter," says the reverend gentleman, in reply, "I have long ago said all I have to say, and *take no further concern in the question*. If any allege he passed on me as ancient poetry what was his own composition, *I have no interest in disputing his allegation*. If I had, I would try if he could write such verses as he claims (no doubt the best) on any other given subject; and examine whether these passages were not *by a dozen or score of other contributors*. Unfortunately for me, not only one, but every contributor, dead or alive, must renounce his right, before I can take the merit of a verse or line, if vanity do not prompt me to take the contribution of such as are dead, and unable to dispute my claim. But this, I think, I shall leave to others; and if they claim the translation as well as the original, I will not dispute it, nor care who may believe and who may doubt it. The stopping of my plough by a shower of rain coming on gives me more concern than either." This is, perhaps, the most extraordinary answer that ever was made to a charge of literary imposture. Dr Graham says, "it will be found replete with good sense;" but, for our part, we discover in it merely a studied evasion of the important question, to which it so much concerned Dr Smith to give a distinct and unequivocal answer. It is some consolation, however, to find, that the strange proceedings in which this gentleman appears to have been engaged, were not, like those of Macpherson, productive of profit. The eyes of the public had already been opened; and, from one of Dr Smith's letters to Mr Mackenzie, we learn that "the *profits* of his publication were only a serious *loss*,"—a circumstance which affected him so sensibly, that he adds, "I could never since think of Gaelic poetry with pleasure or with patience, *except to wish it had been dead before I was born*."

We have thus placed before our readers as complete and comprehensive a view of this famous controversy as our limits would possibly permit. The subject has no doubt lost much of its original attraction; indeed public opinion appears to have gradually settled down into a decided conviction, that the poems of Ossian, as they appear in the pretended translations of Macpherson, are substantially a forgery. But the controversy as to their authenticity or spuriousness, which was for a considerable time carried on with so much acrimony, forms a curious chapter in the literary history of Scotland; and, for this reason alone, we have endeavoured to exhibit a condensed view of the origin, the progress, and, we may add, the termination, of the dispute, at the same time furnishing such collateral information as seemed calculated to throw light upon the principal question agitated by the advocates and opponents of the Ossianic hypothesis. (A.)

OSSIFICATION, in the animal economy, the formation of the bones, but more particularly the conversion of parts naturally soft to the hardness and consistency of bones.

OSTADE, Adrian van, an eminent Dutch painter, was born at Lubeck in 1610. He was a disciple of Francis Hals, in whose school Brouwer was contemporary with him, and in it they contracted an intimate friendship. The subjects of his pencil were always of a low kind; he had nearly the same ideas as Teniers, and diverted himself with clowns and drunkards in stables, ale-houses, and kitchens. His pictures are so transparent and highly finished that they have the polish and lustre of enamel. They have frequently a force superior to Teniers; yet it were to be wished that he had not designed his figures so short. Of the Dutch masters he is perhaps the one who best understood the *chiaro oscuro*; and he was often employed to paint figures for the best landscape painters among his countrymen. He died in 1685. His works, especially those of his best time and manner, are very scarce; and hence, when they can be purchased, no price is thought too much for them. His prints etched by himself, large and small, consist of fifty-four pieces.

OSTEND, a city of Belgium, in the province of West Flanders, and circle of Bruges. It stands on the sea-shore, with a good harbour, and two basins. The entrance to the harbour is narrow, and only passable at high water; and at low water the vessels within are aground. The mouth of the haven is defended by two forts, and the town is surrounded with walls, and protected by two fortresses or citadels, being thus capable of defence against attacks either from the sea or from the land. It is well built; the streets are broad, and the houses good. It is connected by canals with Bruges and Nieuport, which are continued from the latter place to Dunkirk. It contains 10,550 inhabitants, many of whom depend on the sea and the internal navigation, and particularly on the fishery. It has considerable occupation in building ships, and in making sail-cloth and linen goods, besides cables and small cordage. It has also salt-refineries and saw-mills. But it is deficient in good water, which is conveyed from a distance of more than a mile. The siege of this place in the war between the Netherlands and Spain is one of the most memorable that history has recorded. It began in 1601, and ended in 1604, when it was surrendered to the Spaniards, who had lost before it 100,000 men. Long. 2. 28. 48. E. Lat. 51. 13. 37. N.

OSTEOCOLLA, ὀστεοκολλα, in *Natural History*, a white or ash-coloured sparry substance, in shape like a bone, and by some supposed to have the quality of uniting broken bones. It is found in long, thick, and irregularly cylindrical pieces, which are in general hollow, but are sometimes filled up with a marly earth, and sometimes contain within them the remains of a stick, round which the osteocolla had been formed. But though it is plain that many pieces of osteocolla have been formed by incrustations round sticks, yet the greater number are not so; in fact, they are irregularly tubular, and appear to be formed of a flat cake, rolled up in a cylindrical shape. The crusts of which these are composed do not form regular concentric circles round the internal cavity, as must have been the case had they been formed by incrustation. On the other hand, they plainly show that they were once so many thin strata, composing a flat surface, which has afterwards been rolled up, as one might do a paper three or four times doubled, into two, three, or more spiral lines. In this case, each single edge of the paper would be everywhere a regular point of a continued spiral line drawn from a given point; but they would by no means be so many detached concentric circles. The osteocolla is found of different sizes, from that of a crow-quill to the thickness of a man's arm. It is composed of sand and earth, which may be separated by washing the powdered osteocolla with water, and is found both in digging and in several brooks, in many parts of Germany and elsewhere. In some parts of Germany it is called hammosteus, from its always growing in sand, never in clay, or any solid soil, nor even in gravel. Where a piece of it anywhere appears on the surface, they dig down for it, and find the branches run ten or twelve feet deep. They usually run straight down, but sometimes they are found spreading into many parts near the surface, as if it were a subterraneous tree, the main stem of which began at twelve feet depth, and thence grew up in a branched manner till it was met by the open air.

The osteocolla found in the earth is at first soft and ductile, but in half an hour's time, if exposed to the air, it becomes as hard as we find it in the shops. The method of taking up a perfect piece for a specimen is to open the ground, clear away the sand, and leave it so for an hour or thereabouts, in which time it will harden, and may be taken out whole. It is certain that the osteocolla is produced at this time; for if a pit be cleared of it, more will grow there in a year or two, only it will be softer, and will not harden in the air so easily as the other. What the rotten substance resembling the decayed branches of trees is, we cannot determine, unless it really be such; but the opinion of the common people, that it is the root of something, is absurd, because its thickest part lies at the greatest depth, and the branches all run upwards. The osteocolla is a marly spar which concretes round this matter; but what it is that determines it to concrete nowhere on the same ground excepting around these branches, it is difficult to say. The rottenness of this substance, which forms the basis of the osteocolla, renders it very liable to moulder and fall away, and hence it is that we usually see the osteocolla hollow. Sometimes it is found solid; but in this case some vegetable matter has served as its basis, and instead of one branch, it will be found to have concreted about a number of fibres, the remains of which will be detected in it on a close examination.

OSTEOLOGY is that part of anatomy which treats of the bones.

OSTERODE, a city of Hanover, in the province of Grubenhagen and bailiwick of Eimbeck. It is situated at the foot of the Hartz Mountains, on the rivers Sose and Apente, and is surrounded with walls. It contains 760 houses, with 4500 inhabitants. It has a gymnasium with six professors, and contains an extensive corn magazine, always stored with a large quantity of bread-corn for the supply of the miners of the Hartz. It has manufactures of various woollen goods, of cottons, and of hosiery; and, besides, white lead, small shot, snuff, and soap, with other small articles, are made there. Long. 10. 11. 24. E. Lat. 51. 14. 15. N.

OSTERVALD, John Frederic, a celebrated Protestant divine, was born at Neufchatel in 1663. He made such rapid progress in his studies that he became master of arts at Samur before he was sixteen years of age; and he afterwards studied at Orleans and at Paris. On his return to Neufchatel in 1699 he became pastor of the church there, and contracted a strict friendship with John Alphonsus Turretin of Geneva, and Samuel Werenfels of Basil; and the union of these three divines, which was called the Triumvirate of the Divines of Swisserland, lasted till his death. Ostervald acquired the highest reputation by his virtues, and his zeal in instructing his disciples; and he restored ecclesiastical discipline. He wrote many books in French, the principal of which are, 1. a Treatise concerning the Sources of Corruption; 2. a Catechism, or Instruction in the Christian Religion, translated into German, Dutch, and English, with an Abridgment of Sacred History prefixed to it; 3. a Treatise against Impurity; 4. an edition of the French Bible of Geneva, with Arguments and Reflections, folio; 5. Ethica Christiana; and, 6. Theologiæ Compendium. Ostervald died in the year 1747, regretted by all who knew him.

OSTERWICK, a city belonging to the Prussian province of Saxony, and the capital of a circle of the same name, which extends over 270 square miles, and contains 36,000 inhabitants. The city is situated on the river Ise, and is fortified. It contains 480 houses, with 2850 inhabitants, who are occupied in various manufactures, and carry on extensive breweries and distilleries. Long. 10. 36. 48. E. Lat. 51. 58. 18. N.

OSTIA, a town on the eastern coast of Italy, in the territory of the Roman see. It stands near that mouth of the river Tiber called Bocca del Fiumecino, in a marshy and unhealthy spot. It is the seat of a bishop, whose diocese is united with that of Velletria, and contains a large and fine cathedral. It is not on the spot where stood the Ostium of the ancients and the principal maritime establishment of Rome, which was stated to have been three or four miles in circuit, but somewhat farther from the seashore. The remains of the ancient city are still visible in the ruins of aqueducts, temples, and other edifices, which must have been built by a rich and luxurious population. The chief occupation of the few inhabitants consists in collecting salt made by the heat of the sun alone, and with which the greater portion of the papal dominions is supplied. Long. 12. 10. 30. E. Lat. 41. 45. 38. N.

OSTIAKS, an Asiatic tribe, who form the greater proportion of the native population of Siberia. They chiefly inhabit the banks of the Obi, in the government of Tobolsk, extending northward along the river to the frontier of the Samoiedes. They are extremely rude in their habits and manners. Considering indolence as their chief

Ostracism.

enjoyment, they labour only from necessity. They are diminutive in their persons, being rather under than above the middle size; slender in their figures, with thin legs, and their faces pale and not at all strikingly marked. The visages of the men are particularly repulsive; nor do the women possess any superior attractions. They are simple, timid, and full of prejudices; and their only virtue seems to consist in hospitality, which they share in common with other savages. They are clothed in skins, without any shirt; and their lower garment consists of a species of jacket with sleeves, which reaches to the middle, whilst an upper garment, with a cap, is worn in cold weather. The female's attire is not particularly becoming. The head-dress is adorned with bands of cloth fastened by ribbons, and by ear-rings of little coloured pearls. They tattoo also the back of the hand, and the fore part of the arm and of the leg. They are by no means distinguished for cleanliness, owing probably to the hard labour to which they are exposed; the men, as in all barbarous countries, regarding them as slaves. The Ostiaks live chiefly by fishing, and, with all the disgusting filthiness of savages, they eat their fish raw. Some of the rich have herds of rein-deer. With these they migrate along the banks of the rivers in portable tents, composed of pieces of bark sewed together; but in winter they dwell in wooden habitations, covered with earth to increase the heat. The filth and stench of their abodes cannot be described. In winter they sometimes engage in hunting, performing for this purpose long journeys on sledges. They are in general healthy; but when they advance in years they become liable to nervous and scorbutic disorders. The small-pox, in particular, has committed dreadful ravages amongst them. They are exceedingly rude in their religious notions, being generally pagans, and addicted to the grossest idolatries. They have in all their cottages idols, which are like dolls: these are placed in the neatest corner of the tent, with a little table before them to receive the offerings. Here they deposit, for the use of the idol, a large horn of snuff, with little pieces of willow bark, such as are here used for putting into their nostrils; and they often bedaub it with fish oil: but if any misfortune befall them which they imagine the idol might have averted, they cast it on the ground, and break it to pieces. The idols which are the chief objects of worship are in a wooded valley, the approaches to which are carefully guarded. They consist of a man and woman clothed in the Ostiak dress, finely adorned with their richest furs and cloths. The surrounding country is considered as sacred, so that they neither hunt upon it, nor cut down the grass nor any tree. They place great confidence in their sorcerers, and are deluded by the grossest and most absurd superstitions. They were governed, before the Russian conquest, by their own hereditary chiefs, who still administer justice amongst them; and the obedience exacted from them consists chiefly in the regular payment of their tribute of furs. Their amusements consist in dancing, or in romantic tales of their exploits and amorous adventures; and their language has a considerable affinity with that of the Finns. According to the census of 1784, the Ostiaks of the Obi amounted to 30,891 males.

OSTRACISM, in Grecian antiquity, denotes the banishment of such persons as by their merit or their influence gave umbrage to the people of Athens, lest they should attempt any thing against the public liberty. This punishment was called *ostracism*, from the Greek word ὀστρακον, which properly signifies a *shell*; but when applied to this object, it is used to signify the billet upon which the Athenians wrote the names of the citizens they intended to banish. The learned are divided with regard to the substance of which this billet was formed. Some insist that it was a small stone, or a piece of brick; others hold that it was a piece of bark; and others assert that it was a shell. The word admits of all these interpretations; but what determines its true sense, is the epithet applied to it by ancient authors, signifying "the punishment of potter's clay;" and this expression seems to prove, that the word ὀστρακον, when applied on this occasion, signified a "piece of baked earth, in the form of a shell;" an idea which the Latin authors had undoubtedly in their heads when they translated it by *testula*. The ancients are likewise divided respecting the time at which ostracism was instituted, but they all agree that the person who moved the law was its first victim. As to the name of its patron, and the time of its establishment, however, they differ extremely. Many are of opinion that ostracism originated at a very remote period in the history of Athens.

But however this may be, the punishment of ostracism was inflicted by the Athenians when their liberty was believed to be in danger. If, for instance, jealousy or ambition had sowed discord amongst the chiefs of the republic, and if different parties were formed, which threatened some revolution in the state, the people assembled to propose measures proper to be taken for preventing the consequences of a division which in the end might be fatal to freedom. Ostracism was the remedy to which they usually had recourse upon these occasions; and the consultations of the people generally terminated in a decree, by which a day was fixed for a particular assembly, when they were to proceed to the sentence of ostracism. The persons who were threatened with banishment then omitted no assiduity or art calculated to gain them the favour of the people. They made harangues to evince their innocence, and the great injustice which would be done them if they were banished. They solicited, in person, the interest of every citizen; and all their party exerted themselves on their behalf. They also procured informers to vilify the chiefs of the opposite faction. Some time before the meeting of the assembly, a wooden enclosure was raised in the forum, with ten doors, that is, with as many as there were tribes in the republic; and when the appointed day came, the citizens of each tribe entered at their respective door, and threw into the middle of the enclosure the small brick upon which the citizen's name was written whose banishment they voted. The archons and the senate presided at this assembly, and counted the billets. He who was condemned by 6000 of his fellow-citizens was obliged to quit the city within ten days; for 6000 voices, at least, were requisite to banish an Athenian by the ostracism.

The Athenians, without doubt, foresaw the inconveniences to which this law was subject; but they sometimes preferred exposing the innocent to an unjust censure, to living in continual alarms. Yet as they were sensible that the injustice of confounding virtue and vice would be too flagrant, they softened, as much as they could, the rigour of ostracism. It was not aggravated by the circumstances which were most dishonourable and shocking in the ordinary mode of exile, and the goods of those who were banished by ostracism were not confiscated. Such persons enjoyed the produce of their effects in the places to which they were banished, and their banishment was only for a certain time. But in common banishment, the goods of the exiles were always confiscated, and no hopes were given them of ever returning to Athens.

The scholiast of Aristophanes informs us of a third difference between ostracism and the common banishment, namely, that a particular place of retirement was assigned to those who were banished by ostracism, which was not appointed to the other exiles. There is reason, however, to suspect the truth of this observation. Themistocles was certainly not limited in his banishment. That great man, as we are told by Thucydides, though his chief residence was at Argos, travelled over all the Peloponnesus.

This punishment, far from conveying any stigma of infamy, became, by the objects on whom it was inflicted, a proof of merit. Aristides the sophist, in his second declamation against the Gorgias of Plato, justly observes, that ostracism was not an effect of the vindictive spirit of the people against those whom it condemned; that the law, whether good or bad, was only meant to prune the luxuriant growth of transcendent merit; that it condemned to a banishment of ten years only those illustrious men who were accused of being exalted far above other citizens by their conspicuous virtue; and that none of that public indignation was shown to those exiled by ostracism, which commonly breaks out against criminals.

Such were the mitigations with which this law was introduced amongst the Athenians; and from them we perceive that the people were sensible of all the inconveniences to which it was subject. They were indeed too enlightened not to foresee that in many instances it might produce injustice; that if, in some respects, it would be favourable to liberty, in others it would be its enemy, by condemning citizens without allowing them a previous defence, and by making a capricious and envious people arbiters of the fate of great men; and that it might even become pernicious to the state, by depriving it of its best subjects, and rendering the administration of public affairs an odious employment to men of talents and virtue.

OSTRACITES, a name applied to the fossil oysters which are so common in many parts of England.

OSWESTRY, a market-town of the hundred of the same name, in the county of Salop, 182 miles from London, and seventeen from Shrewsbury. It is situated in a fertile district, and has a good market, which is held on Wednesday. Being a frontier town towards Wales, in ancient times it was an important place, frequently harassed, and often burned. The chief trade depends on the canal, which connects it with the Severn, the Dee, and the Mersey. It has a corporation of twelve aldermen and eighteen common councilmen. A recorder is chosen annually, who is generally the mayor of the preceding year. In 1801, the population amounted to 2672, in 1811 to 3479, in 1821 to 3910, and in 1831 to 4478; but the whole parish, at the last census, contained 8581 inhabitants.

OSYMANDES, or OSYMANDYAS, a famous king of Egypt. According to some, he was the first monarch who collected a great number of books for the purpose of forming a library; and this curious collection he is said to have entitled Pharmacy of the Soul.

OTABALO, a district or jurisdiction of South America, in the republic of Colombia, and department of the Equator or Quito. It contains eight towns or villages, the lands belonging to which are laid out in plantations, consisting principally of the sugar-cane; but wheat and barley both thrive uncommonly well. A number of small rivers fertilize the country, which abounds with sheep, black cattle, and horses. Great quantities of butter and cheese are exported; and the native Indians, who still inhabit their ancient territory, are a very industrious people, weaving quilts, cottons, bed-furniture, and carpets of very brilliant colours, which are much esteemed. There are two lakes in Otabalo, each about three miles in length by a mile and a half in breadth, one of which produces a cray-fish that is highly prized in Quito, being the only fresh-water fish that can be had there. The Indians of Otabalo resisted Huana Capac in his expedition against Quito, which so exasperated him that he ordered all who could be found to be beheaded and cast into a small lake in a neighbouring district; from which circumstance it received the name of Yagarchoca, that is, "the bloody lake." The town, which bears the same name as the district, is situated about thirty miles north from Quito, in 0° 15′ north latitude, and 77° 56′ west longitude. In the year 1818 it was said to contain 15,000 inhabitants, a great portion of whom were whites; but the population must have since that period decreased materially. The other towns and villages are not of much importance. Those of Cayambe and Catacatche are situated at the foot of the mountains which severally bear these appellations, the latter being between 16,000 and 17,000 feet above the level of the sea. Near Cayambe, on an eminence, are the ruins of an ancient circular temple, about fifty feet in diameter. Of this edifice nothing remains but the middle walls, which are about five feet in thickness and fifteen feet in height, the whole being constructed of unbaked brick, cemented with a sort of earth. In the plain near this village are numerous tumuli, or burying-places of the ancient inhabitants, which are generally of a conical shape. Many of these are of great size, and have been perforated for the sake of the gold utensils which were deposited in the earth along with the remains of the departed chief. In this manner not a few Spaniards at one time acquired considerable wealth; for in running a gallery through the tumuli, they came upon a number of golden idols, and jewels to a great amount. The ornaments and images made of the precious metals which have from time to time been discovered, are in general beautifully wrought, but thin and hollow. The emeralds also are cut into all sorts of shapes, and perforated with the greatest nicety; displaying altogether a degree of skill and finish far superior to what might have been expected from workmen whose only tools were made of hardened copper or stone.

OTAHA, one of the Society Islands, in the South Pacific Ocean, situated to the north of Ulietea, and surrounded with rocks. It was visited by Captain Cook in 1769, and afterwards, in 1791, by Captain Edwards. Long. 151. 20. W. Lat. 16. 53. S.

OTAHEITE, or TAHITI, a celebrated island of the South Sea, situated in west longitude 149. 13. and south latitude 17. 46., discovered by Captain Wallis in 1767. See the article POLYNESIA.

OTAKOOTAI, or WENOOAETTE, a small island in the South Pacific Ocean, about three miles in circumference, discovered by Captain Cook in 1777. Long. 201. 37. E. Lat. 19. 51. S.

OTHO, M. SALVIUS, a Roman emperor, born in the year 32, and of a family which claimed descent from the ancient kings of Etruria. Being among the number of Nero's favourites, he was raised to the highest offices of the state, and made governor of Pannonia, by the interest of Seneca, who wished to remove him from Rome, lest Nero's love for Poppæa should prove his ruin. After Nero's death, Otho conciliated the favour of Galba, the new emperor; but when he failed to gain his point, and Galba refused to adopt him as his successor, he resolved to make himself absolute, without any regard to the age or dignity of his benefactor. The great debts which he had contracted encouraged his avarice; and having procured the assassination of Galba, he made himself emperor. He was acknowledged by the senate and the Roman people; but the sudden revolt of Vitellius in Germany rendered his situation very precarious, and it was resolved that their respective pretensions to the empire should be decided by arms. Otho obtained three victories; but in a general engagement near Brixellum, his forces were defeated, and he stabbed himself when all hopes of success had vanished. This happened in the thirty-seventh year of his age, after a reign of about three months. It has been justly observed, that the last moments of Otho's life were those of a philosopher. He comforted his soldiers, who lamented his fortune, expressing his concern for their safety; and he observed, that it was better one man should die than that all should be involved in ruin on account of his obstinacy. His nephew was deeply affected, and feared exceedingly the resentment of the conqueror; but Otho comforted him by observing that Vitellius would be kind and affectionate to his friends and relations, since, in the time of their greatest enmity, the mother of Vitellius had received the most friendly treatment at his hands. He also burned all letters which, by falling into the hands of Vitellius, might provoke his resentment against those who had favoured the cause of an unfortunate aspirant to empire. These noble and humane sentiments in a man who was the associate of Nero's disgraceful pleasures, and who had stained his hands with the blood of his master, have appeared to some wonderful, and have passed with others for mere craft and policy, rather than the suggestions of a naturally virtuous and benevolent heart. His father was a favourite of Claudius.

OTLEY, a town of the west riding of Yorkshire, in the wapentake of Skrack, 205 miles from London, and ten from Leeds, with a market on Tuesday. It is situated in a beautiful valley on the river Wharffe. The parish is very extensive, containing three chapelries and ten townships. The population of the town amounted in 1801 to 2332, in 1811 to 2602, in 1821 to 3065, and in 1831 to 3161. That of the parish, at the last census, amounted to 10,163.

OTODINI, ancient Britons, who, as some suppose, occupied the countries now called Northumberland, Merse, and the Lothians, to the north-east of the Brigantes. As the Otodini are not mentioned by any of the Roman historians, and noticed only by Ptolemy, it is consequently uncertain whether they formed a distinct and independent state, or were united with the Brigantes. They were a considerable people, however, and possessed a long tract of the sea-coast, from the river Tyne to the Frith of Forth. Their name is derived by Baxter from the old British words *Ot o dineu*, signifying "a high and rocky shore;" and thus descriptive enough of their country. They were probably reduced by Agricola at the same time with their more powerful neighbours the Brigantes; but as they lived without the wall of Severus, they were, like the rest of the Mæatæ, engaged in frequent revolts. In the most perfect state of the Roman government in this island, the country of the Otodini formed a part of the Roman province called Valentia, which comprehended the large tract between the two walls. As this province was never long in the peaceable possession of the Romans, the latter had but few stations in the country of the Otodini, except those along the line of the wall of Severus. Various authors have derived the name of this people in various ways, and it is very differently spelled; and different opinions seem still to be entertained amongst the learned respecting their real situation. Indeed it is even doubtful whether their country was in England or in Scotland.

OTRAHERMANA, LA, a small island in the Eastern Seas, near the west coast of Lucon. Long. 120. 6. E. Lat. 15. 55. N.

OTRANTO, a province of the kingdom of Naples, on the Italian continent. It is the north-eastern corner of the kingdom, a kind of peninsula in the Mediterranean Sea, extending in north latitude from 39. 47. to 40. 48., and in east longitude from 16. 44. to 18. 41. The other boundaries on the land side are, on the north-west Bari, and on the south-west Basilicata. It is 1650 square miles in extent, and contains 292,100 inhabitants, of whom about 40,000 are said to be Arnauts and Greeks. A continuation of the Apennine chain runs through the centre of the province, but none of the points are very lofty, and they gradually decline in height till they terminate in the sea at Cape Leuca. On both sides of this ridge the land is of moderate quality, chiefly of a calcareous and clayey mixture; and when well fallowed, which, from a scarcity of manure, is the common practice, yields good crops of the common kinds of grain, and abundance of all sorts of pulse. Near to the shore, tobacco, cotton of a good quality, and much liquorice, are grown; and on the sides of the hills some very strong, if not well-flavoured wine, is produced, and also much olive oil. Silk is neglected, although the soil and climate are favourable to mulberry trees. Honey and wax are obtained in every village in plenty. There are no minerals, and the manufactures are insignificant. The chief city is Lecce.

OTTAJANO, a city of Italy, in the province Terra di Lavoro, in the kingdom of Naples. It is a large place, in a district producing considerable quantities of silk and olive oil, and abundant crops of corn. It contains three parish churches, and, including the adjacent village, 14,200 inhabitants.

OTTERBURN, a township in the parish of Eilsdon, of the county of Northumberland, and ward of Coquetdale, 308 miles from London, and thirty-two from Newcastle. It is remarkable for the battle fought there in ~~1388~~, between Henry Percy, usually called Hotspur, and the Earl of Douglas, a conflict which gave rise to the ancient ballad of Chevy Chase. It is on the north side of the Cheviot Hills, and the population amounts to about 400.

OTTERY, ST MARY, a market-town of Devonshire, in the hundred of the same name, and 167 miles from London. It is situated on the river Otter, has a market which is held on Tuesday, some trade in making serges, and some in pillow-lace. In 1801 the population amounted to 2415, in 1811 to 2880, in 1821 to 3522, and in 1831 to 3849.

OTTICOTTA, a town of Hindustan, in the Carnatic, thirty-three miles north-east from Madras. Long. 81. 1. E. Lat. 13. 21. N.

OTUNGURRA, a town of Hindustan, in the province of Bahar, and district of Chuta Nagpore. Long. 85. 42. E. Lat. 23. N.

OTWAY, THOMAS, an eminent tragic poet, was the son of Mr Humphrey Otway, rector of Woolbeding, in Sussex, and was born at Trottin, in that county, on the 3d of March 1651. He received the rudiments of his education at Winchester school, and in 1669 was entered a commoner of Christ-Church; but, from whatever cause, he left the university without a degree, and proceeded to London, where he commenced player. In 1672, he made his first appearance on the stage in the character of the king in the *Forced Marriage*, though with indifferent success, and soon found that he was not likely to gain much reputation as an actor. This inability to shine on the stage Otway shared with Shakspeare and Jonson, as he likewise shared some of their excellencies. It seems reasonable to expect, indeed, that a great dramatic poet should without difficulty become a great actor; that he who can feel might also express; that the man who can excite passion should be able to exhibit readily its external modes and indications. But experience has fully proved that, whatever be the affinity of these powers, one of them may be possessed in a great degree by a person who has very little of the other; and that they either depend on different faculties, or a different use of the same faculty. The actor must possess a pliancy of mien, a flexibility of countenance, and a variety of intonation, in which the poet may easily be supposed deficient; or the attention of each may have been differently employed, the poet considering thought and the player action, the one watching the heart and the other contemplating the expression of the countenance.

Otway, however, though sensible of his inability to attract notice as an actor, felt conscious of possessing powers which qualified him for becoming a dramatic author; and, under this impression, his very first attempt was made in the highest department of the art. His tragedy of *Alcibiades* was acted at the Theatre Royal in 1675, though with what measure of success we are not informed. The story is taken from Nepos and Plutarch; but in certain points he departs from history in order to accommodate the character of his hero to the effect which he wished to produce. *Don Carlos*, another tragedy in heroic verse, founded on St Real's novel of the same name, and the Spanish chronicles of the life of Philip II., was performed in 1676, and appears to have succeeded much better than any other of his plays. For many years indeed it was more applauded and followed than either *Venice Preserved* or *The Orphan;* and it is even asserted that it was played for thirty nights together, though this may reasonably be doubted. At any rate, it was very successful, and brought more money than any preceding tragedy.[1] In 1677, Otway produced *Titus and Berenice*, a piece in three acts, translated with alterations from Racine; and also *The Cheats of Scapin*, a farce partly taken from Molière; which were acted together with considerable success, the custom of annexing farces to plays having about that time been introduced. His comedy of *Friendship in Fashion*, which appeared in 1678, had also some success, though it seems doubtful whether the author was at this time in London, as he certainly went abroad during the year 1677.

The occasion of his going abroad will be immediately explained. Johnson, however, in introducing this circumstance, observes: "Want of morals, or of decency, did not in those days exclude any man from the company of the wealthy and the gay, if he brought with him any powers of entertainment; and Otway is said to have been at this time a favourite companion of the dissolute wits. But as he who desires no virtue in his companion has no virtue in himself, those whom Otway frequented had no purpose of doing more for him than to pay his reckoning. They desired only to drink and laugh; their fondness was without benevolence, and their familiarity without friendship." Men of wit received at that time no favour from the great except that of sharing their riots, from which they were dismissed again to their own narrow circumstances; and thus they languished in poverty without support, and often without resource. But some exception must, nevertheless, be made. The Earl of Plymouth, a natural son of the king, procured Otway a cornet's commission in some troops which were then, 1677, destined for Flanders. But the poet did not prosper in his military capacity. The society of dissolute wits had but ill qualified him for submitting to the restraints of discipline, or observing that regularity which the laws of the service required; and hence, having left his commission behind him, he returned to London, where he resumed his dramatic labours.

In 1680, he produced *Caius Marius*, a tragedy, which had some success, probably from the circumstance of the author having availed himself of the excitement that then prevailed about the Popish Plot; and, in the dissensions of Marius and Sylla, endeavoured to shadow forth the proceedings of the factions in the reign of Charles I. But a higher degree of fame awaited him from his next tragedy, *The Orphan*, which appeared the same year. This, as Johnson observes, is one of the few pieces which have kept possession of the stage, and pleased through all the vicissitudes of dramatic taste and fashion. It is a domestic tragedy, drawn from middle life, and its whole power is upon the affections. *The Soldier's Fortune*, and its second part, *The Atheist*, produced respectively in 1681 and 1684, were both successful, being far better suited to the manners of that age than to those of the present. The incidents and characters may, for the most part, be traced to other plays, and neither is in any respect worthy of the genius which, in 1682, gave to dramatic literature *Venice Preserved*, a tragedy, the fame of which, like that of *The Orphan*, is secure against all the caprices of taste and fashion, whilst it displays still higher powers of poetry and of expression. The striking passages are familiar to all, and its faults as well as its excellencies seem to have been rightly appreciated by the public. It is, in fact, the production of a man not very attentive to decency, nor over zealous for virtue, but of one who conceived forcibly, and drew originally by consulting nature in his own breast. Besides the plays already mentioned, he wrote the miscellaneous poems inserted in Johnson's series of the poets; and he translated from the French a History of the Triumvirate.

But Otway's career was destined to be a short one. He died before completing his thirty-fourth year, on the 14th of April 1685, in a manner which has been variously represented; but, according to every account, in circumstances of the deepest distress. "Having," says Johnson, "been compelled by his necessities to contract debts, and hunted, as is supposed, by the terriers of the law, he retired to a public-house on Tower Hill, where he is said to have died of want; or, as is related by one of his biographers, by swallowing, after a long fast, a piece of bread which charity had supplied. He went out, as is reported, almost naked, in the rage of hunger, and finding a gentleman in a neighbouring coffee-house, asked him for a shilling. The gentleman gave him a guinea, and Otway going away bought a roll, and was choked with the first mouthful. All this, I hope," adds Johnson, "is not true; and there is this ground of better hope, that Pope, who lived near enough to be well informed, relates, in Spence's Memorials, that he died of fever caught by violent pursuit of a *thief* who had *robbed* one of his friends. But that indigence, and its concomitants, sorrow and despondency, pressed hard upon him, has never been denied, whatever immediate cause might bring him to the grave." Pope's account of Otway's death was first related by Warton in the notes to his Essay on that poet; and it differs in several particulars from the version of it given by Johnson. It would appear that an intimate friend of Otway's having been *murdered* in the street, the poet pursued the murderer on foot as far as Dover, where he was seized with a fever, occasioned by the fatigue, which afterwards carried him to his grave in London. By this account the robber is a murderer; and as Warton was more correct in stating facts than Johnson, it is probable that he relates the story exactly as he heard it. But it may nevertheless be traced to Spence, who, it seems, was informed by Dennis, the critic, that Otway had a friend, named Blakiston, who was shot in the street; that the murderer having fled towards Dover, Otway pursued him; and that, on his return, having drunk water when violently heated, he caught the fever which caused his death. Dennis, however, in the preface to his Observations on Pope's Translation of Homer, 1717, 8vo, says merely that Otway died in an alehouse; a statement which is not inconsistent with the preceding account, as, in point of fact, he generally lived in one. As to the story of the guinea and the loaf, it rests upon no sufficient authority, and may probably have been introduced to heighten the picture of the poet's distress, about which, unfortunately, there can be no doubt whatever. Some, however, are inclined to think that both accounts might be true. But this cannot be, for the supposition of Otway having died of fever, occasioned by fatigue, or by drinking cold water when violently heated, is

[1] This circumstance is coarsely alluded to by Rochester in the *Session of the Poets:*

Tom Otway came next, Tom Shadwell's dear zany,
And swears, for heroics he writes best of any;
Don Carlos his pockets so amply had filled,
That his mange was quite cur'd, and his lice were all kill'd.

altogether inconsistent with the story of his running half naked into the street in the rage of hunger, and being choked with the first mouthful of the bread purchased with the money that had been charitably given him. No one ever heard or knew of a patient in high fever being seized with raging hunger, and greedily devouring the first morsel of bread he could procure. The idea is altogether absurd.

When Otway first began to rise in reputation, Dryden spoke slightingly of his performances; but afterwards, when *The Orphan* and *Venice Preserved* had established his fame, fully acknowledged their merits. "To express the passions which are seated in the heart by outward signs," says he in his preface to Dufresnoy, "is one great precept of the painters, and very difficult to perform. In poetry the very same passions and motions of the mind are to be expressed; and in this consists the principal difficulty, as well as the excellency, of that art. This, says Dufresnoy, is the gift of Jupiter; and, to speak in the same heathen language, we call it the gift of our Apollo, not to be obtained by pains or study, if we are not born to it. For the motions which are studied are never so natural as those which break out in the height of a real passion. Mr Otway possessed this part as thoroughly as any of the ancients or moderns. I will not defend every thing in his *Venice Preserved;* but I must bear this testimony to his memory, that the passions are truly touched in it, though perhaps there is somewhat to be desired both in the grounds of them, and in the height and elegancy of the expression. But *nature is there*, which is the greatest beauty." This is high, and, at the same time, discriminating praise. Otway's power consisted in moving the passions and touching the heart. All the fountains of feeling were at his command, and he could throw them open at his pleasure. His mastery over the emotions as well as the passions of the soul was unrivalled. But he had not much cultivated versification, nor replenished his mind with general knowledge; and hence his numbers are sometimes harsh, and his allusions neither rich, varied, nor striking. "Nature," however, "is there," and her presence atones for every deficiency.

It appears that Otway, when he died, had about him the copy of a tragedy which he had sold for a trifle to Bentley the bookseller. An advertisement which appeared in L'Estrange's *Observator* for the 27th November and the 4th December 1686, in which a reward is offered to any person who "can give notice in whose hands the copy lies," leaves no doubt whatever of the fact. The play in question, however, seems to have been irrecoverably lost; for the tragedy entitled *Heroic Friendship*, which was printed in 1719, and attributed to Otway, is evidently no production of his. It never was acted, nor deserved to be acted. (A.)

Otway, *Cape*, a high and rocky promontory upon the south coast of New Holland. Long. 143. 29. E. Lat. 38. 51. S.

OTWEILER, a city of Prussia, in the province of the Lower Rhine, in the government of Treves. It is the capital of a circle of the same name, which extends over 178 square miles, and comprehends three towns and forty-seven communes, with 17,500 inhabitants. The city is situated on the river Blies, and contains two churches, 320 houses, and 2730 inhabitants, who are employed in making cloth, and some china-ware.

OUCH, a very ancient town of Hindustan, in the province of Moultan, the capital of a district, and probably the Oxydracoe of the Greeks. It is situated between the river Indus and the Sutlege or Hyphasis, and within the territories of the Bahawulpoor rajah. It is seventy-five miles south by west from the city of Moultan. Long. 70. 50. E. Lat. 29. 11. N

OUDANULLA, a small town of Bengal, in the district of Rajemahl, situated at the foot of a range of hills which approach near to the western bank of the Ganges. Near the town are the remains of a handsome stone bridge, a very fine specimen of modern Mahommedan architecture, built by the Sultan Sujah between 1640 and 1660. It was near this place that Major Andrews, in 1764, attacked and gallantly stormed the entrenched camp of the Nabob Cossim Ally. Long. 87. 45. E. Lat. 24. 55. N.

OUDE, a province of Hindustan, situated between the twenty-sixth and twenty-eighth degrees of north latitude. On the north it is bounded by various petty districts tributary to Nepaul, from which it is separated by intervening hills and forests; on the south by Allahabad; on the east by Bahar; and on the west by Delhi and Agra. It is about 250 miles in length by 100 in breadth.

This province is part of the extensive plains of Hindustan, and is level in its surface, and extremely well watered, the Goggrah and Goompty Rivers running through it, both navigable by boats at all seasons of the year, and having the Ganges for its western boundary, besides numerous streams and lakes which intersect it in different directions. The soil is fertile, and, when properly cultivated, is exceedingly productive, yielding abundant crops of wheat, barley, rice, and a variety of other grains, cotton, sugar-cane, indigo, and poppies, and all the staple articles raised in India. It also produces grapes, mangoes, and other fruits. To the north-east the ground rises, and the country abounds in extensive woods and plains covered with grass, which afford cover for game and wild animals of all kinds. The air and the climate are suited to the spontaneous generation of nitre, from the brine of which an inferior kind of salt is produced. Lapis lazuli is also produced in this province; and a variety of cotton cloths and a coarse kind of flannel are made; also bows, arrows, shields, matchlocks, and swords. The climate is more temperate than that of Bengal. The hot winds commence about the middle of March, and blow with violence till about the beginning of June; but the inhabitants, nevertheless, contrive to keep their apartments very cool; and to the natives the hot winds are not unhealthy, however injurious to European constitutions. The rains are neither so violent nor of such long duration as in Bengal; and the temperature during the four cold months of the year is delightful. The principal towns of the province are Lucknow, Fyzabad, Oude, Khyrabad, Ghoorackpore, and Bahreich. The inhabitants are about one third Mahommedans; the remainder are Hindus of all castes. "All the villages," says Heber (vol. ii. p. 49), "have pagodas, while many are without mosques." They are a superior race both in body and in mind to the feeble natives of Bengal and of the districts round Calcutta. The Rajpoots, more especially, are distinguished by robust frames and by their military air, as well as by the more solid qualities of soldiers. The military habits of the population were long fostered by the disorderly state of the province, which, though it has no doubt improved, still affords too many opportunities to the freebooter.

Oude is celebrated in the ancient historical poems of Hindustan as an opulent and splendid empire, which extended all over the south of India, and even as far as the island of Ceylon. But these fabulous exaggerations are not deserving of credit. It was in the thirteenth century that Oude was conquered by the Mahommedan kings of Delhi, to whose empire it remained attached until its separation after the death of Aurungzebe, when it shared the fate of all the other parts of his kingdom, and from a dependent province grew up into an independent state. The first ancestor of the present ruler of Oude was Saadut Khan, a native of Rishapoor, in the province of Khorassan, who was appointed subahdar of Oude during the reign of Mahommed Shah. He was by birth a Persian, and came to India as a soldier of fortune; but by his courage and ad-

Oude.

dress he rose by degrees to the rank of general in the imperial service, and was sent to the government of Oude. Having no sons, he sent for his nephew Mirza Mokiem to Persia, and gave him in marriage his only daughter, born of a concubine. He also introduced him into the imperial service, with the title of Suffder Jung, the defeater of armies. Saadut Khan died by taking poison, in consequence of the humiliating treatment he experienced from Nadir Shah, who invaded and overran India in the year 1739; and his son-in-law having secured possession of his treasure, succeeded to the throne, and was confirmed in the government of Oude by the emperor Mahommed Shah. Suffder Jung's reign was prosperous and successful. In the year 1747 he repulsed Ahmed Abdally, king of the Afghans; and, as the reward of his valour, he was honoured with the title of Abul Munsur, the victorious, and appointed prime minister, which was the origin of the title of vizier in his family. In addition to Oude, he also obtained a grant of the province of Allahabad; and at length, finding his influence upon the decline, and tired of the intrigues of the court, he died in 1753, or, according to some, in 1756. He was succeeded without opposition by Shuja ud Dowlah, who was successful in all his measures, until he took part with Cossim Ally Khan against the British, and was defeated by them in the battle of Buxar in the year 1764 (see HINDUSTAN, vol. xi. p. 419). He died in 1775, and was quietly succeeded by his eldest son Asoph ud Dowlah, a weak prince, who died in 1797. Having no legitimate children, he nominated one of his adopted sons, Vizier Aly, as his successor, who was dethroned by the British on account of his illegitimacy, and Saadut Ali, the eldest brother of the deceased nabob, was raised to the supreme power. It was in his reign that his dominions were dismembered, during the administration of the Marquis Wellesley; for an account of which the reader is referred to the article HINDUSTAN. The nabob of Oude had long agreed to pay an annual contribution to the East India Company, but was constantly in arrear, from the mismanagement of his affairs. On this account it was that, in lieu of this contribution, a portion of his territories was ceded to the Company, he being left sole ruler of the remaining portion. Great complaints have always been made against him by the British for the mal-administration of his dominions, which, there is no doubt, have often been a scene of serious disorders. He died in the year 1814, leaving a treasure, it is said, of many millions. Having been long on bad terms with his eldest son, he nominated his second as his successor. But the British, whose influence was now undisputed, refused to confirm his bequest, and elevated to the supreme power the eldest son, Ghazi ud Deen. The first act of the new ruler, in a conference which he had at Cawnpoor with the governor-general, was to solicit the acceptance of a crore (10,000,000) of rupees as a free gift. This was however declined, excepting as a subscription to the loan of six per cent. which was then open; and he afterwards agreed to the permanent assignment of 651,000 rupees annually, in payment of pensions due from the Oude treasury, under the guarantee of the British government. The Nepaulese war being protracted to a second campaign, and great preparations being made, and expense incurred, in the Pindarrie war, a hint was conveyed to the nabob that a second loan of a crore of rupees would be acceptable; and the nabob, knowing, no doubt, the power of those by whom the hint was given, cheerfully complied, and the amount was paid in bullion at Lucknow, from the treasures of his father. For the first time, the strip of low country, or Terriani, which bounds the hills, and which was taken from the Nepaulese, was given him, at his own suggestion. It is asserted, on the same authority of course, that he voluntarily tendered to the British the free gift of a crore of rupees. This territory which he consented to receive is either, as Bishop Heber mentions, a savage wilderness, or "occupied by a race of mountaineers, who pay no taxes without being compelled, and whom he has not the means of compelling." In short, the whole transaction, both the voluntary offer and the free gift, bears the aspect of fraud and extortion.

For more than fifty years the British have been interfering in the affairs of Oude, and under this superintendence the country has been gradually falling into decay and disorder. Their professed object has been to improve the interior administration, and the collection of the revenue. But in this case it is deeply to be regretted that their efforts should have been attended with so little success; for, according to the latest accounts, the country is a scene, in many parts, of anarchy, disorder, and extortion. The minister of the nabob, Hukeem Mendee, a man of considerable opulence, and, according to Heber, as respectable in his private conduct as most of the ministers in the East are expected to be, was dismissed at the instigation of the British; and a series of violent measures followed, in which many of the zemindars were proscribed and banished. Heber asserts,[1] that the worst consequence of the two loans to the British was, that it laid them under an obligation to the nabob, and prevented them from urging such measures as would have been necessary for the reform of the interior administration of the country. Hukeem Mendee, the displaced minister, had been continually introducing improvements in the collection of the revenue, after the examples afforded in the British provinces. The system adopted by the nabob was that of employing collectors or assessors, or officers who united both these duties, and whose sole object was to extort as much as possible from the impoverished peasantry and landholders, and to whose oppression there was no check. "In consequence," says Bishop Heber (vol. ii. p. 82), "three or four times more than the sums really due were often extorted by these locusts, who went down and encamped in different parts of the country, and, under various pretences, so devoured and worried the people that they were glad to get rid of them on any terms. Nay, sometimes, when one aumeen had made his bargain with the land-owners and tenants, and received the greater part of the payment in advance, a second would make his appearance with more recent powers (having outbid his predecessors), and begin assessing and collecting anew, telling the plundered villagers that they had done wrong to pay before it was due, and that they must look to the first man for re-payment of what they had been defrauded of. 'All this has been done,' was said to me, 'and the king will neither see it nor hear it.' It was not likely, however, to be done long without resistance. The stronger zemindars built mud-forts, the poor ryots planted bamboos and thorny jungle round their villages; every man that had not a sword sold his garment to procure one, and they bade the king's officers keep their distance. The next step, however, of government, was to call in the aid of British troops to quell these insurgents. This the king of Oude had, by the letter and spirit of existing treaties, a right to do. His father and uncle had purchased this right by the cession of nearly one third of their whole territories, by the admission of two or three garrisons of subsidiary troops into their remaining provinces, and by the disbanding of by far the greater part of their own army, on the express condition that the English should undertake to defend them against all external and internal enemies. Still Saadut Ali had used this right very sparingly. He was not fond of admitting, far less requesting, any more foreign interference

[1] Narrative of a Journey through the Upper Provinces of India, vol. ii. p. 81.

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than he could help. And his own guards, consisting of two thousand regular infantry, one thousand horse, three hundred artillery, and the irregulars whom I have noticed, were enough for all usual occasions, and were in excellent order and discipline. Now, however, all was changed. The soldiers themselves were so ill paid that it was difficult to keep them together; the artillery, a beautiful little corps, first mutinied, and then disbanded themselves to the last man; and the king had really no option between either altering his system, or governing without taxes, or calling in British aid. That aid was demanded and given; and during the greater part of Lord Hastings's time this wretched country was pillaged under sanction of the British name, and under the terror of Sepoy bayonets, till at length the remonstrances of the British officers employed on this service became so urgent, and the scandal so notorious and so great, not to omit that the number of the disaffected increased daily, and that, the more parties were sent out in support of the aumeens (collectors), the more were called for, while every peasant who lost lands or property in the progress of the system became a decoit (gang-robber), and made inroads into the company's provinces, that a different course was imperiously forced on government."

The British resident was instructed to urge anew on the king a system of efficient reform. But he was extremely averse to the interference of the British, and accordingly the resident was instructed to decline granting military aid, unless some previous reforms should be carried into effect, and unless an English commissioner versed in such matters were allowed to accompany the detachment, and to determine, before resorting to extreme measures, on the justice of the collector's claims. The nabob evaded these peremptory demands, and begged that, as a preliminary step, the British force should be employed in putting down the rebellious zemindars, in destroying their mud-forts, and in disarming the people. Bishop Heber, however, observes, that the territories are in a far better state of cultivation than he expected to find them. From Lucknow to Sandee he says that the country is as populous and well cultivated as most of the Company's provinces. Since the aid of the British troops has been withheld, he adds that affairs have been in all respects growing better. The zemindars have in a few instances carried their point, and the collectors have been either driven away, or forced to accept a moderate compromise; and the chief sufferers are the king, who gets little or nothing of his undoubted dues, and the traveller, who, unless he has a guard, had better, as Bishop Heber recommends, sleep in a safe skin on the other side of the Ganges. "It should be observed, however," the same acute observer continues, "that I have as yet seen no sign of those mud-forts, stockades, and fortresses, on which the zemindars and peasantry are said to rely for safety; that the common people north of Lucknow are, I think, not so universally loaded with arms as those to the southward; and that though I have heard a good deal all the way of the distressed state of the country, as well as its anarchy and lawlessness, except in the single instance I have mentioned, where the treasure was attacked, I have *seen* no signs of either, or had any reason to suppose that the king's writ does not pass current, or that our aumeen would have the least difficulty in enforcing it in our favour, even without the small payment which I give, and which is evidently accepted as a gratuity. I cannot but suspect, therefore, that the misfortunes and anarchy of Oude are somewhat overrated, though it is certain that so fine a land will take a long time in ruining, and that very many years of oppression will be required to depopulate a country which produces on the same soil, and with no aid but irrigation, crops of wheat and pulse every year."

The territories of Oude reserved for the nabob occupy about 21,000 British square miles, and contain a population of at least 3,000,000 of inhabitants.

Oude.
Oudeypoor.

OUDE, a town in the province of Oude, and the ancient capital of the above-mentioned province. It was long the residence of a Hindu dynasty, and subsequently the seat of the provincial government. It is situated on the south side of the Dewah or Goggrah River. It is described as having formerly been a city of vast extent; but nothing now remains to attest its former magnificence but a heap of ruins. It is still considered, however, as a place of great sanctity, and a resort of Hindu pilgrimage. In its vicinity are two remarkably large tombs of great antiquity, and venerated by the Mahommedans as the tombs of Seth and Job. There are no documents to tell at what period the seat of government was removed to Lucknow. But after the battle of Buxar in 1764, the nabob Shujah ud Dowlah founded the city of Fyzabad on the ruins of the ancient city of Oude, and the old city was in consequence demolished. It is eighty-five miles travelling distance east from Lucknow. Long. 82. 10. E. Lat. 26. 45. N.

OUDENARDE, a circle of the province of East Flanders, in Belgium, divided into eight cantons and 119 communes, and containing 156,500 inhabitants. The capital is the city of that name, situated in a fertile valley on the banks of the Scheldt. It is well built, and contains 950 houses, with 5300 inhabitants, who carry on extensive manufactures of fine linen. Lat. 50. 50. 40. N.

OUDEYPOOR, a Rajpoot principality in the province of Ajmeer, of which it occupies the south-eastern quarter. It is situated between the 24th and 26th degrees of north latitude. This territory formerly bore the appellation of Mewar or Meyar, and its chief is frequently styled in history the Rana of Chitore. So disorderly has for a long time past been the state of the country, that it is difficult to fix the real extent of the Oudeypoor territories, though they may be considered generally as comprehending the districts of Chitore and Mewar. In this view, they are bounded on the north by the Joudpoor territories; on the south by many native principalities in the provinces of Gujerat and Malwah; on the east by the territories of Kotah, Boondee, and Sindia; and on the west by the large district of Sarawy, nominally subject to Joudpoor. The whole area in 1818 might be estimated at 7300 square miles. The chief, who is of the Rajpoot or military tribe, the children of the sun, is esteemed to be of the proudest lineage in Hindustan. He is considered as the most noble of the Rajpoot chiefs, though he is much inferior in temporal power to the rajahs of Jeypoor and Joudpoor. He is said to be descended in the female line from Noushirvan the Just, who was sovereign of Persia at the birth of Mahommed; and thus he claims a common origin with the Seids, descended from Hossein the son of Ali. On this account he is much revered by the Mahommedans. The face of the country is in general rather hilly than mountainous, but when properly cultivated it is extremely fertile. It is watered by many streams, independently of the periodical rains; and yields in abundance sugar, indigo, tobacco, wheat, rice, and barley. It also possesses iron and sulphur mines, and abundance of fuel. It is a strong country, full of wild fastnesses and intricate paths. The country formerly possessed tin mines, which produced about three lacs of rupees annually, besides rich copper-mines in various parts. It is mentioned by Colonel Todd, that great riches were formerly extracted from these mines; but the miners are now dead, and the mines filled with water; and though a recent attempt has been made to work them, it was so unprofitable that the design was soon abandoned.

The Rajpoots form the aristocracy of the country, and are esteemed one of the purest of the Hindu tribes, and the most elevated in rank. The rights by which property is held in Oudeypoor, as well as throughout Northern India, Oudey-poor.

and everywhere, indeed, except where they have been obliterated by conquest, are defined with singular perspicuity by Lieutenant-colonel Todd, in his great work on Rajasthan, in which the lights of philosophy are combined with the most laborious research, and a deep skill in the mysteries of Hindu literature. In the article HINDUSTAN we have endeavoured to give a view of the state of landed property throughout India; and in this province, where the ancient laws and customs still survive the rage of conquest, the ryot or cultivator is the original proprietor of the soil. This is, according to the learned writer referred to, an inherent right, which force only can destroy; whilst the title of the government is confined to a fixed rent; so that it is a common saying, "The government is owner of the rent, but I am master of the land." It is under this title that the land is held by the great chieftains and military vassals; the only claim of the crown being for a quit-rent, which in many cases has been commuted for military service. Land, however, is held by other tenures, as by a grant from the crown in lieu of services; and this grant may be recalled. But so sacred has the grant from the ryot been considered, that even monarchs have held lands on this tenure from their subjects. In the confusion and civil wars which distracted the country, many of these rights were lost; even the government dues were rarely levied, except by force; and the feudatories as rarely obeyed the summons of the chief to appear at his court. The province of Oudeypoor, together with Northern India, shared in the general confusion; and the repeated invasions of Scindia had spread such disorder throughout the country, that the revenues could not be collected. That of the rana had declined to eight or nine lacs of rupees; whilst petty states, such as Shahpoorah, Sherghur, and others, everywhere set up claims of independence. In consequence of these depredations, and the general disorder that reigned in the country, the rana was reduced to great poverty. His lands were usurped by predatory bands, and by the more systematic encroachments of Scindia and Holkar. A convention was agreed upon by the different chiefs, by which all extortion and plunder were to be suppressed. But though the most sacred oaths were exchanged in ratification of this treaty, the old scenes soon recommenced with increased violence. From this degrading bondage the rana of Oudeypoor was rescued by the interference of the British, who, as usual, exacted for their good offices a large tribute. His condition was, however, somewhat improved; his chiefs and nobles, and former feudatories, daily repairing to offer him their obeisance. But his poverty still continued, whilst his subjects were oppressed by his rapacious officers, who came in place of the plundering banditti who had been expelled by the power of the British government. The destruction of that predatory system under which Central India, and Oudeypoor amongst the other states, was so long oppressed, disorderly bands of Pindarries plundering the country, and connived at or assisted by Scindia and Holkar, was effected in the short campaign of 1817, when the Indian armies were all directed to march on Central India, and, not content with a defensive war, to attack the plunderers in their remote haunts, and entirely to root them up. The success of this war restored peace to Central India, and delivered the different rajahs and feudatories from the merciless exactions of the military banditti who had desolated the country.

"Of all the princes who obtained succour at this momentous crisis in the political history of India," says Colonel Todd, "none stood more in need of it than the rana of Oodipoor. On the 16th January 1818 the treaty was signed; and in February an envoy was nominated, who immediately proceeded to the rana's court to superintend and maintain the newly-formed relations. The right wing of the grand army had already preceded him, to compel the surrender of such territory as was unjustly held by the lawless partisans of Scindia, and to reduce to obedience the refractory nobles, to whom anarchy was endeared, from long familiarity." The strongholds of the country were soon surrendered to the victorious army, and tranquillity was restored. But an awful scene of ruin was exhibited. The rana, in his passage from Jehajpoor to Romulmer, a space of about 140 miles, at the time when he re-entered on the possession of his territories, found only two thinly-peopled towns, which acknowledged his authority. "All," says Colonel Todd, "was desolate; even the traces of the footsteps of man were effaced. The babool (*mimosa Arabica*) and gigantic reed, which harboured the boar and the tiger, grew upon the highways; and every rising ground displayed a mass of ruin." He adds, that he passed through Bhilwara, the commercial entrepôt of Rajpootana, in May 1806, when it was comparatively flourishing, and contained 6000 families. In 1818 it showed not a vestige of human existence. "All was silent in her streets; no living thing was seen, except a solitary dog, that fled in dismay from his lurking place in the temple, scared at the unaccustomed sight of man." Oudeypoor, the capital of the country, which formerly contained 50,000 houses within its walls, had not now 3000 occupied; the rest were in ruins, the rafters being taken for fire-wood. The produce to the revenue from the spring harvest of 1818 was only L.4000. Grain sold for three times the price at which it could be purchased within a distance of eighty miles; and the rana, whose ancestors had opposed Baber, Akbar, and Aurungzebe, during the splendour of the Mogul sovereignty, had not fifty horse to attend him, and was mainly indebted to Zalim Sing of Kotah for the means of subsistence. It was out of this state of confusion that order was to be restored. But the elements of prosperity, though scattered, were not extinct. The first point was the recognition of the prince's authority by his nobles, the surest sign of which was their presence in the capital; and such was now the paramount influence of British authority, that in a few weeks the rana saw himself surrounded by a court such as had not been known for half a century, and the whole feudal association of Mewar was embodied in the capital. Colonel Todd, in his great work already referred to, gives a striking picture of the restoration of order and prosperity in this country.

"To recall the exiled population," says he, "was a measure simultaneous with the assembling of the nobles; but this was a work requiring time. They had formed ties and incurred obligations to the societies which had sheltered them, which could not at once be disengaged or annulled. But wherever a subject of Mewar existed, proclamations penetrated, and satisfactory assurances were obtained, and realized to an extent which belied in the strongest manner the assertion that patriotism is unknown to the natives of Hindustan. The most enthusiastic and cheering proofs were afforded, that neither oppression from without, nor tyranny within, could expel the feeling for the '*bapota*,' the land of their fathers. Even now, though time has chastened the impressions, we should fear to pen but a tithe of the proofs of devotion of the husbandman of Mewar to the *solum natale;* it would be deemed romance by those who never contemplated humanity in its reflux from misery and despair to the sweet influences of hope. He alone who had witnessed the day of trouble, and beheld the progress of desolation, the standing corn grazed by Mahratta horse, the rifled towns devoted to the flames, the cattle driven to the camp, and the chief men seized as hostages for money never to be realized, could appreciate their deliverance. To be permitted to see these evils banished; to behold the survivors of oppression congregated from the most distant provinces, many of them strangers to each other, and the aged and the helpless awaiting the *lucky day* to take possession of their ruined abodes; was a sight which memory will not part with. Thus, on the 3d of Sawun (July), a favourite day with the husbandman, three hundred of all conditions, with their waggons and implements of labour, and preceded by banners and music, marched into Kupasun; and Ganésa was once again invoked, as they reconsecrated their dwellings, and placed his portrait as the Janus of their portals. On the same day, and within eight months subsequent to the signature of the treaty, above three hundred towns and villages were simultaneously re-inhabited; and the land, which for many years had been a stranger to the ploughshare, was broken up. Well might the superstitious fancy that miracles were abroad; for even to those who beheld the work in progression it had a magical result, to see the waste covered with habitations, and the verdant corn growing in the fields where lately they had roused the boar from his retreat. It was a day of pride for Britain. By such exertions of her power in these distant lands her sway is hallowed. By Britain alone can this fair picture be defaced; the tranquillity and independence she has conferred, by her alone may be disturbed."

To give effect to all the measures necessary for the improvement of the country, proclamations were issued by the rana, inviting foreign merchants and bankers to establish connections in the chief towns throughout the country; branch banks were everywhere formed, and mercantile agents fixed in every town in the country; the shackles that bound external commerce were at once removed, and the multifarious posts for the collections of transit levies abolished; in lieu of which chain of stations, all levies on goods in transit were confined to the frontiers. Under this system, of which peace was the object, the country improved. Bhilwara, the chief commercial mart, rose rapidly from ruin, and in a few months contained 1200 houses, half of which were occupied by foreign merchants. In 1822 it contained nearly 3000 dwellings, inhabited by merchants, bankers, or artisans. Notwithstanding various obstacles to the prosperity of the country, from an impoverished court, avaricious and corrupt officers, the discontent of the head men of the village, and bad seasons, the general prosperity advanced rapidly; and of this the increase of the revenue and population, as exhibited below, is a sure index.

Abstract of the land and commercial revenues of Mewar in the following years: Spring harvest of 1818, 40,000 rupees; of 1819, 451,281; of 1820, 659,100; of 1821, 1,018,478; of 1822, 936,640. Comparative population of the chief towns before and after four years of peace:—

	No. of houses in 1818.	No. in 1822.
Oodipoor	3500	10,000
Bhilwara	none	2,700
Poorh	200	1,200
Mandel	80	400
Gooosonda	60	350

OUDGHIR, a populous village of Hindustan, situated in the province of Bejapore, with a small fort and handsome cypress garden. It is in the nizam's dominions, and is 115 miles north-west from Hyderabad. Long. 77. 25. E. Lat. 18. 19. N.

OUEINING, a city of China, of the first rank, situated on a fine lake in an extensive plain, surrounded with high mountains. Long. 103. 50. E. Lat. 26. 45. N.

OUE-KIUN, a city of China, of the first rank, in Honan, being situated on a river, in a sandy plain and barren soil.

OUEN-TCHEOU, a city of China, of the first rank, in Tchekiang, situated on a river, with a good harbour. Long. 129. 29. E. Lat. 28. 1. N.

OUFA, a considerable city of Asiatic Russia, and capital of the government of Orenburg. It is situated on the banks of the Belaia, near its junction with the Oufa; part of it is a species of hollow resembling a cavern, and its site is intersected by numerous torrents and ravines. It was built in 1573, by the Czar Ivan Vassilievitch, as a station to collect the tribute of the Baschkirs, and as a barrier against the inroads of the Kirghisses. It was once fortified; but the fortifications have now fallen into decay, the danger of invasion having diminished with the extension of the frontier. This place is the residence of the primate, who bears the title of Archbishop of Orenburg and Oufa. It contains about 1000 houses, and nearly 2500 inhabitants of both sexes. It has seven churches, two convents, one of which is destined for nuns, an academy, and two schools. The surrounding country is fertile, abounding in forests and pastures, and well suited for the rearing of bees; and the Tartars who dwell in the neighbourhood, being the most diligent and industrious cultivators in Siberia, have acquired considerable wealth. It is asserted that there was formerly on the spot where Oufa stands a great Tartar city, the residence of the khans of the Nogais; and this tradition is confirmed by many ancient relics found near the city, amongst which are two mosques built of brick, and several remarkable sepulchral monuments, with Asiatic and Cufic inscriptions. Long. 56. 18. E. Lat. 54. 42. N.

Oufa, a considerable river of Russia, which rises in the Oural Mountains, and falls into the Belaia, near the city of Oufa. Its course is through a mountainous and fertile country; and several of its tributary streams have rich mines of iron on their banks.

OUGHTRED, William, an eminent mathematician, was born at Eton in 1573, and educated in the school there, whence he was elected to King's College, Cambridge, of which he afterwards became fellow. Being admitted to holy orders, he left the university about the year 1603, and was presented to the rectory of Aldbury, near Guildford in Surrey; and about the year 1628 he was appointed by the Earl of Arundel to instruct his son in the mathematics. He kept a correspondence by letters with some of the most eminent scholars of his time on mathematical subjects; and the most celebrated mathematicians of the age owed most of their skill to him, his house being full of young gentlemen who came from all parts to receive his instruction. It is said that, upon hearing the news of the vote at Westminster for the restoration of Charles II. he expired in a sudden transport of joy, at the age of eighty-eight. He wrote, 1. *Clavis Mathematica*, which was afterwards published in England; 2. A Description of the Double Horizontal Dial; 3. *Opuscula Mathematica;* and several other works.

OUKESIMA, an island in the Chinese Sea, near the coast of Tonquin, about thirty miles in circumference. Long. 105. 42. E. Lat. 18. 44. N.

OULLER Lake, a lake of Hindustan, in the province of Cashmere, into which the river Behut or Jhylum pours its stream. Long. 73. 50. E. Lat. 34. 22. N.

OUNCE, a weight, the sixteenth part of a pound avoirdupois, and the twelfth part of a pound troy. The word is derived from the Latin, *uncia*, the twelfth part of any whole, called *as;* and, in geometrical measures, an inch, or twelfth part of a foot.

OUND, a village of Hindustan, in the Mahratta territories, and province of Bejapoor. The surrounding district is the property of Scindia's family. It is nine miles from Poonah.

OUNDLE, a market-town of the county of Northampton, and the hundred of Polebrook, seventy-eight miles from London, and sixteen from Stamford. It has a good market, which is held on Saturday, and is nearly surrounded by the river Nen, over which are two bridges, one of them a curiosity, from the number of its arches, as well as from the causeway leading to it. The population amounted in 1801 to 1956, in 1811 to 1833, in 1821 to 2150, and in 1831 to 2308.

OURCHA, a town of Hindustan, in the province of Allahabad, and district of Bundelcund. The rajah was formerly a person of great note; but his revenue is now reduced to one lac, and his consequence has sunk in proportion. He is still considered as the head of the petty chiefs of Bundelcund.

OURAL MOUNTAINS, a remarkable and extensive range of mountains, which has its commencement in the interior of Asia, in the territory of the Kirghisses, between the Caspian and the Aral, and stretches about due north along the sources of the Oural, the Tobol, the Emba, the Petchora, and the Sosva, by a course very imperfectly known, but, it is supposed, nearly parallel to the course of the Obi, to the shores of the Northern Ocean, and across that ocean throughout the whole length of Nova Zembla. It forms, during the greater part of its course, the boundary between Northern Asia and Russia in Europe. The soil and the country are very various, great part of these mountains being little else than lofty and barren deserts. Hence this extensive tract is divided into the Oural of the Kirghisses, the mining district of the Oural, and the desert regions. No accurate information has been obtained, excepting regarding the mining district, which contains extensive mines of iron and copper, with several of gold and of platina. Great establishments have been formed in these desert parts for the working of the mines, the produce of which has been increasing in value for the last twenty years. Besides these metals, the Oural Mountains also produce varied and beautiful specimens of minerals, as jasper, quartz, petrosilex, agate, calcedony, rock crystal, topaz, amethyst, chrysolite, asbestos, amianthus, and others. The Oural Mountains slope much more on the western than on the eastern side; and on the former there is a collateral chain, which contains rich veins of copper. Many of the loftiest pinnacles are composed of granite, which appears below in large masses; and they reach above the level of perpetual snow. The sides, particularly the western, are composed of schistus, whilst, in the lower parts, calcareous rocks predominate. These mountains are covered in many parts with forests, in which are generally found pines, cedars, larches, and other natives of a northern climate; and in the south-west parts are found the oak and the ash. Between the mountains are seen fine pasture-grounds, rich valleys, and beautiful meadows, in which numerous herds of cattle are bred. The country is well watered, both by numerous rivers, and fine transparent lakes full of fish.

OURAL, a large river of Asiatic Russia, formerly called by the name of Yaik. It received its present appellation in the year 1775. It has its rise in the Oural Mountains, in about 54° north latitude, and runs westward a great part of its course, after which it turns directly south, and falls into the Caspian, nearly in 47° north latitude, and 53° east longitude. It forms the boundary between the Kirghisses and the Baschkirs; has a rapid current, with a pure stream; and everywhere abounds with fish, the fisheries on its banks affording an inexhaustible source of wealth to the Cossacks. It has very steep and rocky banks whilst it is a mountain stream; but afterwards flows through a dry and saline plain.

OURALSK, a large and populous city, with narrow and irregularly built houses, the capital of the Oural Cossacks. The male inhabitants, who amount to 3600, are divided into seven regiments, which are under the general superintendence of the governor-general of Orenburg. They are chiefly employed in taking fish, which are very abundant in the Oural, and are considered to be superior in quality to those caught in the Caspian. The place is surrounded with palisades and an irregular rampart. Long. 52. 6. E. Lat. 50. 11. N.

OURFA. See ORFA.

OUROOMIA, or OOROMIA, the chief town of a district or government of the same name, in Persia, situated on a large lake, also of the same name, in the province of Azerbijan. It is an ancient city, which, according to Sir Robert K. Porter, once bore the name of Thebarma; and is mentioned as a place of some consequence by Strabo. It is surrounded with walls and towers, which are at present in a very ruinous state, though, with a shallow ditch, they constitute its only means of defence. It is, however, beautifully situated amidst the most extensive and luxuriant gardens, producing almost every European and Asiatic fruit in the greatest plenty and perfection. The town contains, according to Frazer, about 20,000 inhabitants, who are of disorderly habits, being mostly the immediate retainers of chiefs who, having their property in the neighbourhood, reside in large palaces within the town. The latter have constant feuds with each other, in which their retainers take part; and the governor, who is a chief of the Affshar tribe, being quite unable to restrain them, more murders are committed in the town of Ouroomia than in any other city of Persia. It is sixty miles west of Tabreez. Long. 46. 12. E. Lat. 37 58. N.

OUROOMIA, *Lake*, a noble expanse of water, about 100 miles in length, stretching nearly north and south, and about forty miles in breadth. It is surrounded by picturesque mountains, and valleys which are fertile and well filled with villages. It lies to the south-east of Koiy, at no great distance from the city; and is generally considered as the Spauto and Marcianus of Strabo and Ptolemy. Its waters, like those of the sea, appear of a dark blue colour, streaked with green, according as the light falls on them; they are perfectly clear, and intensely salt. According to an experiment by the late Mr Brown, they were found to contain one third more salt than the sea. A great quantity of salt is also deposited on the shores, and on the bottom, which is seen for a considerable distance, from the clearness of the water. In some places there is an incrustation of salt towards the margin, from under which, when broken, thick concentrated brine rushes out; and the deposition of salt and saline efflorescence extends in some places many hundred yards from the water's edge, encircling it with a belt of glittering white. No fish or living thing, says Frazer, as far as is known, has been found in this fine lake. Within the last twelve or fourteen years, the same traveller was informed that the waters had gone back, and left the shore dry, in some places, to a distance of full 500 yards. From the village of Sheraff-Khaneh, built upon a bank once overhanging the water, it has retired, leaving a mud beach, covered with salt or saline efflorescence, of many hundred yards in breadth. A finer subject for inland navigation than this lake and its tributary streams can scarcely be conceived. The country from Tabreez to its bank is level, and the river Adjai, which passes the town, could easily be converted into a canal, or made to feed one; and by this channel the valuable produce of all the districts around the lake of Ouroomia might be brought to the capital at a trifling expense. But the spirit of enterprise in Persia is broken under the influence of a despotic and unstable government; and hence it is in vain to expect that capital will ever be employed in any useful improvement. So little disposition is there to take advantage of this lake for inland navigation, that there is not a single boat upon it. There were formerly two; but one was wrecked, with the loss of eight men, and the other was allowed to rot. The district or government of Ouroomia contains, according to Frazer, 400, and to Sir Robert K. Porter, 700 villages. It has been ruled by the present governor and his family for 200 years. Its revenue amounted for twenty-five years to 7000 tomaums, or about L.15,000 annually. But since the rivalry of certain noblemen with each other for the government, it has been increased to L.100,000, which is wrung from the poor peasantry by the most cruel extortion.

OURRY'S ISLAND, or NEW ALDERNEY, an island in the South Pacific Ocean, discovered by Captain Carteret.

in 1767. It is one of the Queen Charlotte Islands, and is ten miles long and five broad. Long. 165. 19. E. Lat. 11. 10. S.

OUSE, Greater, a river which rises near Fitwell, in Oxfordshire, and proceeds to Buckingham, Stony Stratford, and Newport-Pagnel, in Buckinghamshire; from thence it proceeds to Bedford, and turning north-east, it passes on to Huntingdon and Ely, till at length it arrives at Lynn-Regis, in Norfolk, and falls into the sea.

Ouse, *Smaller*, rises in Suffolk, and, separating that county from Norfolk on the south-west, discharges itself into the Great Ouse near Downham. There is still another of the same name, which rises on the west-north-west side of Yorkshire, and running chiefly to the south-east, at length falls into the Humber.

OUSSOOR, a town of Hindustan, in the Mysore rajah's territories, which surrendered to a British detachment in 1791. Long. 78. E. Lat. 12. 45. N.

OUTCHANG-FOU, a city of China, of the first rank, situated on the great river Yang-tse-kiang, at its junction with the Han. It is the capital of the province of Houquang, and when joined to Hang-yang-fou, situated on the opposite side of the river, and forming properly one with it, it ranks with the largest cities in China, or in the world. From its position at the junction of the great river Yang-tse-kiang with the Han, it enjoys an easy commercial intercourse with almost every port of China. Though nearly 500 miles from the sea, the river is deep enough to float the largest vessels; and, for some miles in the vicinity of the city, it is entirely covered with barks, amounting to 8000 or 10,000, many of which form the only habitation of numerous Chinese families. This interminable prospect and forest of masts presents one of the most striking scenes in the world. The surrounding country is noted for the excellence of the tea which it produces; and the bamboo paper manufactured here is very highly celebrated all over China.

OU-TCHEOU, a city of China, of the first rank, in the province of Quang-see. It is favourably situated for commerce, as the whole rivers of the province meet under its walls in their progress to Quang-tong. The surrounding country is mountainous. The rhinoceros is found in the neighbouring rivers. Long. 110. 32. E. Lat. 23. 38. N.

OUTING, a city of China, of the first rank, in the province of Yunan, situated in a fertile country, near a range of very rugged mountains, which yield abundance of musk. It is exposed to the inroads of the mountaineers, for which reason a considerable garrison is maintained in the place. Long. 102. 6. E. Lat. 25. 53. N.

OUTLAW signifies one who is deprived of the benefit of the law, and therefore held to be out of the king's protection.

OUTLAWRY, the punishment of a person who, being called into court, and sought, according to the usual forms, does contemptuously refuse to appear.

OUVAROFSKOI, a fort of Asiatic Russia, in the government of Tomsk. It is agreeably situated, contains twenty houses, and has been erected as a bulwark against the Kirghisses.

OVAL, an oblong curvilinear figure, otherwise called *ellipse*. The proper oval, or egg shape, however, differs considerably from that of the ellipse, being an irregular figure, narrower at one end than at another; whereas the ellipse or mathematical oval is equally broad at each end. But it must be owned that these two are commonly confounded, even geometricians calling the oval a *false ellipse*.

OVATION, in Roman antiquity, was a lesser triumph, allowed to commanders for victories won without the effusion of blood, or for defeating a mean and inconsiderable enemy. The show generally began at the Alban Mountain, whence the general with his retinue made his entry into the city on foot, with many flutes or pipes sounding in concert as he passed along, and wearing a garland or myrtle as a token of peace. The term *ovation*, according to Servius, is derived from *ovis*, a sheep, because on this occasion the conqueror sacrificed a sheep, as in a triumph he sacrificed a bull. The senate, knights, and principal plebeians assisted at the procession, which concluded at the Capitol, where rams were sacrificed to Jupiter. The first ovation was granted to Publius Posthumius, for his victory over the Sabines in the 253d year of Rome.

OVEN, a kind of domestic furnace, used for baking bread, pies, tarts, and the like. It is of a circular structure, with a very low roof, well lined both on the top, bottom, and sides, with stone; and it has a small entrance in the front, fitted with a door, which being clapped to the mouth of the oven, confines the heat, whilst bread, pies, or puddings, are baking. Over this pastry-cooks have another oven built much in the same manner, which is used for such things as require a less degree of heat. Ovens are heated by burning in them dry faggots, wood, &c. till all the parts are equally hot.

OVERALL, John, a celebrated English bishop, was born in 1559, and, after a proper foundation in grammatical learning, was sent to St John's College, Cambridge, and elected a scholar of that society; but having afterwards removed to Trinity, he was chosen fellow of that college. In 1596 he was made regius professor of divinity, when he took his degree of doctor, and about the same time was elected master of Catherine Hall. In 1601 he was promoted to the deanery of St Paul's, London, by the recommendation of his patron, Sir Fulke Greville, and Queen Elizabeth; and in the beginning of King James's reign he was chosen prolocutor of the lower house of convocation. In 1612 he was appointed one of the first governors of the Charter-House Hospital, then just founded by Mr Thomas Sutton. In April 1614 he was made Bishop of Litchfield and Coventry; and in 1618 he was translated to Norwich, where he died in May 1619, at the age of about sixty. He was buried in that cathedral, where he lay unnoticed and forgotten till some years after the restoration of Charles II., when Cosin, bishop of Durham, who had been his secretary, erected a monument, with a Latin inscription, in which he is said to be "Vir undequaque doctissimus, et omni encomio major."

Wood observes, that he had the character of being the best scholastic divine in England; and Cosin, who perhaps may be thought to rival him in that sort of learning, calls himself his scholar, and declares that he derived all his knowledge from Overall. He is also celebrated by Smith for his distinguished wisdom, erudition, and piety. In the controversy about predestination and grace, which in his time divided the reformed churches, he held a middle opinion, inclining somewhat to Arminianism. He seems indeed to have paved the way for the reception of that doctrine in England, where it was generally embraced a few years afterwards, chiefly by the authority and influence of Archbishop Laud. Overall cultivated a particular friendship with Gerard Vossius and Grotius, and was much grieved to see the love of peace, and the projects of the latter to obtain it, so ill repaid. He himself laboured heartily to settle the differences in Holland, upon what is known by the name of the Quinquarticular Controversy; as appears in part by his letters to the two learned correspondents just mentioned, some of which are printed in the *Epistolæ Præstantium Virorum.*

This bishop is known in England chiefly by his Convocation Book, of which Burnet gives the following account: "This book was wrote on the subject of government, the divine institution of which was very positively asserted. It was read in convocation, and passed by that body, in order to the publishing of it, in opposition to the principles ury laid down in the famous book of Parsons the Jesuit, published under the name of Doleman. But King James did not like a convocation entering into such a theory of politics; so he discouraged the printing of it, especially since, in order to justify the owning of the United Provinces, who had lately thrown off the Spanish yoke, to be a lawful government, it was laid down, that when a change of government was brought to a thorough settlement, it was then to be owned and submitted to, as a work of the providence of God. Here it slept, till Archbishop Sancroft, who had got the book into his own hands, and not observing the last-mentioned passage in it, resolved to publish it, in the beginning of King William's reign, as an authentic declaration which the Church of England had made in the point of non-resistance. Accordingly it was published in quarto, as well as licensed, by him, a very few days before he was under suspension for not taking the oaths.

OVERBURY, Sir Thomas, a learned Englishman, was born in 1581, and studied at Queen's College, Oxford, after which he removed to the Middle Temple, London. He then travelled for some time, and returned a most accomplished person; after which he contracted an intimate acquaintance with Sir Robert Carr, knight of the Bath, who being soon afterwards taken into his majesty's favour, procured Overbury the honour of knighthood. Sir Thomas perceiving the familiarity which subsisted between his patron Carr, now Viscount Rochester, and the Lady Frances, the wife of Robert Earl of Essex, was so much displeased at it that he endeavoured to dissuade Lord Rochester from keeping her company, and from proceeding in the base design he had formed of having her first divorced from her husband, and then marrying her. The viscount, resenting this honest advice, told all he had said to the lady, who was as remarkable for her wickedness as for her beauty; upon which they immediately resolved to effect his destruction. About this time, the king having occasion to send an ambassador abroad, Rochester recommended Sir Thomas Overbury. His majesty approved the choice, and the viscount imparted the king's intentions to Sir Thomas; but, under a treacherous show of friendship, dissuaded him from accepting of that employment, as it might hinder him from a better way of advancement, promising that he would prevent his majesty from being displeased at his refusal. The viscount then went to the king, and having artfully incensed his majesty against Sir Thomas for refusing to obey his commands, the latter was, on the 21st of April 1613, committed for contempt to the Tower, where he continued a prisoner till he was despatched by poison on the 15th of September following. About two years afterwards the whole contrivance of his death was discovered. On this several persons were condemned and executed; but though Carr, now Earl of Somerset, and the Lady Frances, his countess, were condemned to death for contriving the murder, and hiring the persons who were concerned in it, the king only banished them from court, and afterwards pardoned them. Sir Thomas Overbury obtained considerable reputation as an author, both in prose and in verse; but it is probable that the compassion excited by his unhappy end may have at first imparted to his works a degree of popularity which they have not since retained. The principal are, 1. The Wife, a long poem, filled with sentiments, maxims, and observations, such as considerable experience and a correct judgment of mankind could alone supply; and, 2. Characters and Descriptions of the Properties of Sundry Persons, which afford a favourable specimen of his prose style.

OVERHAULING, the act of opening and extending the several parts of a tackle, or other assemblage of ropes, communicating with blocks or dead eyes. It is used to remove those blocks to a sufficient distance from each other, that they may again be placed in a state of action, so as to produce the effect required.

Overhauling is also vulgarly employed to signify an examination or inspection of the condition of a person or thing.

OVERRAKE, a nautical term. When a ship riding at anchor so overbeats herself into a high sea that she is washed by the waves breaking in upon her, then it is said that the waves overrake her.

OVERT, the same with open. Thus an overt act signifies an act which in law must be clearly proved; and such must be alleged in every indictment for high treason.

OVERTON, a town of Flintshire, in North Wales, in the hundred of Maylor, 183 miles from London and eight from Wrexham. It stands on the river Dee. In 1801 the population amounted to 1233, in 1811 to 1563, in 1821 to 1668, and in 1831 to 1746.

Overton, a town of the hundred of that name, in the division of Kingsclere, in the county of Hampshire, fifty-three miles from London. It was formerly a borough, and sent two members to parliament, but has long lost its charter. In 1801 the population amounted to 1130, in 1811 to 1178, in 1821 to 1341, and in 1831 to 1507.

OVERTURE, in *Music*, a piece of instrumental music which precedes an opera, a ballet of action, a cantata, &c. Amongst the finest modern overtures are Mozart's to "Il Flauto Magico," and to "Don Giovanni;" also some of Cherubini's and Beethoven's. Some of Rossini's, Weber's, and Spohr's have likewise great merit.

OVERYSSEL, one of the provinces of the kingdom of the Netherlands. It extends in east longitude from 5. 44. to 6. 59., and in north latitude from 52. 6. to 53. 52., and covers 1342 square miles. It is bounded on the north by Friesland and Drenthe, on the east by Hanover and Prussian Westphalia, on the south by Guelders, and on the west by Guelders and the Zuyder Zee. The face of the country is level, and the land sandy, a great part being covered with heaths, and other parts fertile land for grazing cattle, but marshy. The climate is foggy. This province is watered by the river Yssel and other smaller streams; and its productions are oats, buck-wheat, potatoes, apples, plums, flax, hemp, and turf for fuel. It breeds good horses. In 1831 the inhabitants amounted to 178,980, of whom 117,130 were Protestants, 59,360 Catholics, and the rest Jews. Zwolle is the capital.

OVIDIUS, P. Naso, one of the most celebrated of the Roman poets, was born at Sulmo, a city of the Peligni, on the 20th of March, B.C. 43., the very year in which Cicero lost his life. His father, who was of equestrian rank, bestowed on his son the best education that Rome could furnish, and this was afterwards improved by a residence at Athens. On his return to Rome he applied himself to law, and we find him in succession triumvir, centumvir, and decemvir. He soon found, however, that such a course of life did not suit his inclination; and withdrawing himself from active business, he devoted his whole time to the study of poetry. He was three times married; but his first two wives he divorced, and to his third, who was of the family of the Fabii, he was passionately attached. His daughter Perilla appears also to have been a favourite. With Virgil he could have been but little acquainted, as the Mantuan bard died when Ovid had scarcely attained his twenty-fifth year; but he was the intimate friend of Propertius, Catullus, and Cornelius Gallus. He passed many peaceful years in Rome, enjoying all the pleasures of a luxurious capital, and pursuing his favourite studies; but at last some of his proceedings having excited the displeasure of Augustus, he was ordered to retire from Rome, and take up his residence at Tomi, a city of the Getæ, situated near the mouth of the Danube. What really was the cause of his banishment is a point which has been much discussed by the learned; but as the poet always speaks of it in dark and obscure terms, no satisfactory solution has as yet been suggested. It would appear to have been something of which he had been an innocent witness, and which he had been indiscreet enough to mention to his friends on some convivial occasion. As Julia, the niece of Augustus, was at this time banished on account of her shameless debaucheries, some have imagined that Ovid's punishment might have arisen from participation in her pleasures, or from some indiscreet disclosure of them. It has even been suggested that the lady whom he celebrates under the name of Corinna was no other than Julia; but this is impossible, as he himself states that he was only about his twentieth year when he sung her praises; and his banishment took place about his fiftieth year. Others have suggested that it arose from the disclosure of some state secret respecting Agrippa, the nephew of Augustus, who had been banished to Campania; but there is nothing in the works either of Ovid or of any ancient author that can enable us to come to any satisfactory conclusion. Ovid did not submit to the inconveniences of exile without murmuring, nor was he willing to allow himself to be forgotten. He showed that his mind was completely enervated by the luxurious life he had led at Rome; and he allowed himself to make the most abject entreaties to Augustus to procure his recall; but neither Augustus, nor after him Tiberius, would listen to his request. He remained at Tomi till the time of his death, which happened in the eighth year of his banishment, and the fifty-ninth of his age, A. D. 16.

Ovid's principal work is entitled *Metamorphoseon Libri*, probably from the Latin language not affording a word equally expressive of the author's meaning. They contain, in fifteen books, a series of about three hundred and fifty fables, which begin with Chaos, and end with the death of Cæsar; and they are so arranged that one fable seems to arise naturally from the other. The poet has shown much art in selecting those fables which were suited to his purpose, and in uniting into one consistent whole, materials which differ so much in form and in character. He has also contrived to throw into his work much dramatic spirit, which keeps up the attention of the reader, and gives a liveliness to every scene which he describes. No poet has succeeded better in painting the passions and affections which agitate the breast of man. The materials for his work are no doubt mainly drawn from the Greeks, and more particularly from the Alexandrine school, by which this subject had been frequently treated. He has borrowed much from Nicander, who also afforded materials for the work of Antoninus Liberalis, a Greek of the later ages. We possess a Greek translation of the Metamorphoses by Manuel Planudes.

His work entitled *Amorum Libri* consists of forty-nine elegies, and was originally divided, as he himself states, into five books; but he omitted two. The subject of these elegies is the poet himself and his love-adventures, which he describes with the utmost freedom and sincerity. The passions which moved him, and the feelings he experienced, are expressed with all the lightness of touch and grace so peculiar to the poet, and which has taken off much of the grossness that is natural to such a subject. According to a German critic, this work must have been published somewhere between 744 and 752 U. C. (B. C. 10–2).

His work entitled *Tristia*, in fifty elegies, and *Epistolæ ex Ponto*, forty-six elegies, in four books, were both composed at Tomi during his exile, the first between the years 762–765 (A. D. 9–12), and the second between 765–969 (A. D. 12–16). Both contain heavy and unceasing complaints of the unhappiness of his fate; but the constant repetition of the same idea produces a disagreeable effect; and the unmanliness of his grief does not tend to raise his character in the mind of the reader. The versification of these works, however, is perfect.

The *Heroïdes* are a series of love-letters written by heroines of the mythological age, to their absent lovers. Ovid does not appear to have borrowed the idea of this species of elegy from any Greek writer, though some have been inclined to suspect that such was the case. We possess twenty-one of these letters, but the genuineness of the last six has been doubted, some ascribing them to the pen of Aulus Sabinus. Love forms the subject of them all, with complaints of the absence of lovers; but the different circumstances in which each is placed have enabled the poet to throw much agreeable variety into the letters. The feelings are described with much truth; and though the simplicity of an earlier age is sometimes to be regretted, still they must be considered as one of the most successful of his works.

The *Fasti* is another work of very high merit, in which he describes the origin and customs observed in different Roman festivals, in chronological order. The six books which we possess include only the first six months of the year, though the poet intended to have completed in the same manner the circle of the year, but was prevented probably by his banishment. The subject is one which enabled him to display his historical and mythological learning; and as he seems to have taken much interest in the investigation of the ancient native religion of Italy, this poem is one of the chief sources from which we gather the customs and superstitions of those early times.

The bibliography of Ovid is immense; indeed the different editions of his works, together with the commentaries, and the translations, would fill a volume. We shall here confine ourselves to the citation of the principal editions. These are, 1. The Bologna edition, Azzoguidi, 1471, in folio, being the first book printed at Bologna; 2. That of Rome, Conrad Sweynheym and Arnold Pannartz, 1471, in two volumes folio, published under the auspices of the Bishop of Alenia; 3. Those published by the Alduses, at Venice, about the beginning of the sixteenth century, which are greatly esteemed, particularly that of 1502, 1503, in three vols. 8vo, and that of 1515, 1516, also in three vols. 8vo, with notes by Navagero; 4. The Leyden edition, 1661, 1662, in three vols. 8vo, *cum notis variorum*, brought out under the superintendence of Cnipping; and, 5. That of Amsterdam, 1727, in four vols. 4to, being the beautiful edition of Burmann. The French translations are exceedingly numerous, and, upon the whole, the best that have appeared in any modern language.

OVIEDO, a city of Spain, in the province of Asturias, of which it is the capital. It is situated between the rivers Nalon and Nora, on a hill of granite, and enjoys a serene atmosphere, although generally rather rainy. Its fields are fertile, and yield abundance of fruits and horticultural vegetables; and near it there are good meadows, where cattle are depastured, and hay made for the winter consumption of stock. The city contains a population of 6000 inhabitants, amongst whom there are some of the most distinguished families of the province, who unfortunately prefer a residence in cities to living on their own estates. It is not a place of trade, but rather the resort of lawyers and clergy. It has a very magnificent cathedral in the Gothic style, with a remarkable lofty tower, an university, a well-endowed hospital, and a beautiful public walk. It is supplied with water by a fine aqueduct, which conveys it from two fountains in the neighbouring hills. Long. 5. 56. 22. W. Lat. 43. 21. 55. N.

OVIEDO, *John Gonsales*, in Spanish, Gonçalo Hermandez de Oviedo y Valdez, a celebrated historian, was born at Madrid about the year 1478, and educated amongst the pages of Ferdinand and Isabella. Oviedo had attained the age of fifteen when Christopher Columbus returned from his first voyage; and being seized with a strong desire to learn the details relating to the great discovery of the illustrious navigator, he soon made himself acquainted with all that had passed in this wonderful expedition. Having embraced the profession of arms, he distinguished himself in the war of Naples, where he rendered important service to Spain; and it was in recompense of his talents and bravery that Ferdinand appointed him director of the gold and silver mines in the island of Haïti, which Columbus named first *Española*, and then *San-Domingo*. Oviedo proceeded to his destination in 1513; and employed in working the mines, which were poor compared with those afterwards discovered in the continent of America, the natives of the island, a good and gentle race, naturally indolent, and by no means robust, with constitutions already enfeebled by the ravages of syphilis, a disease previously unknown in the old world. This unfortunate people, who had received the companions of Columbus with so much cordiality, Oviedo treated worse than beasts of burden; compelling them to labour without intermission, and exercising the greatest cruelties to enforce submission to his commands on the part of a race which had previously lived in idleness, subsisting on the abundant natural productions of the climate, and on fish, which they caught without difficulty, as an amusement rather than an occupation. The abominable tyranny to which the natives were thus subjected soon caused a considerable diminution of their number; and Oviedo, in order to justify himself for the oppression and cruelty which he exercised, had the bad faith to allege, in his writings, that the Haïtians were dissolute, unprincipled, and in every respect deserving of extermination. Nor was this all. Not content with calumniating the people he had so cruelly treated, he added the ridiculous falsehood, that amongst them syphilis was the result of debauchery; whereas, according to the testimony of all impartial historians, it had been ascertained by Columbus that the Haïtian people were comparatively indifferent to sexual pleasure, a circumstance by no means common in a burning climate, and which can only be explained by the weak physical organization of these islanders, or by a deficiency of vital power. A residence of nearly twelve years in Haïti enabled Oviedo to study the natural history of the island in all its parts, to observe syphilis in all its types, and to ascertain the remedies which the natives employed in their treatment of the disease. The principal of these was the gaïac, which is still classed amongst the number of the antisyphilitics. On his return to Spain in 1525, Oviedo published a journal of his researches under the title of *Summario de la Historia General y Natural de las Indias Occidentales*, Toledo, one vol. folio, dedicated to Charles V. At a later period, however, the author recast this production, to which he added numerous facts connected with the natural history of Haïti, and, in 1535, he published the first twenty books of his great work entitled *La Historia General y Natural de las Indias Occidentales;* but the entire work, which is divided into fifty books, did not appear till 1783, when it came out under the auspices of the Marquis of Truxillo. Oviedo affirms, in his narrative, that the syphilis is an endemic malady in the island of Haïti, and that having been contracted there by the Spaniards belonging to the expedition of Columbus, it was by them communicated to the Neapolitans belonging to the expedition of Gonçalvo de Cordova; and, in point of fact, the syphilis appeared at Naples immediately after the return of the squadron of Gonçalvo. Several writers, who pretend that syphilis existed in Europe anterior to the discovery of the new world, have attempted to prove this hypothetical assertion from the writings of Oviedo himself; but these, so far from countenancing any such notion, contain incontestible proof of the error into which those persons have fallen who ascribe the origin of this fearful scourge to the old continent. Some authors assure us that Oviedo, having been infected by syphilis during his sojourn at Naples about the year 1513, came to the conclusion that it had been imported from Haïti; and conceiving that there must exist in that island a remedy for the disease, solicited the employment which led him thither, and in fact discovered that the wood of gaïac was the infallible antidote employed by the natives, and by which also he effected his own cure. It is added that, on his return to Spain, Oviedo commenced physician for syphilitic maladies, in the treatment of which he made use of the wood of gaïac, with a success which considerably augmented the fortune he had acquired in working the mines of Haïti, at the expense of the lives of a great number of the natives. (A.)

OVILIA, or SEPTA, in ancient Rome, a place in the Campus Martius, at first railed in like a sheep-pen, but afterwards adorned with marble, and beautified with walks, galleries, and a tribunal or seat of justice. Within this precinct or enclosure the people were called to give their suffrages for the election of magistrates. The ascent into the ovilia was not by stairs, but by *pontes*, or narrow boards, laid there for the occasion. On this account, *de ponte dejici* signified to be deprived of the privilege of voting; and persons thus dealt with were called *depontani*.

OVIPAROUS, a term applied to such animals as bring forth their young from eggs; as birds, insects, and others.

OVOLO, or OVUM, in *Architecture*, a round moulding, the profile or sweep of which, in the Ionic and Composite capitals, is usually a quadrant of a circle; and hence it is also commonly called the *quarter-round*. It is usually cut with representations of eggs and arrow-heads or anchors placed alternately.

OWEN, DR JOHN, an eminent and learned dissenting minister, was born in 1616, at Hadham, in Oxfordshire, of which place his father was vicar. He made such surprising proficiency in learning, that at twelve years of age he was admitted into Queen's College, Oxford; and in 1635 he was made master of arts. Having disapproved of the new regulations introduced by Archbishop Laud, the chancellor, he refused to comply with them, and in 1637 was obliged to leave the university. When he took orders he became chaplain to Sir Robert Dormer of Ascot, in Oxfordshire, and was at the same time tutor to his eldest son. He was afterwards chaplain to John Lord Lovelace of Hurley, in Berkshire. When the civil war broke out, he openly espoused the cause of the parliament; which was so resented by an uncle who had intended to leave him his estate, that he discarded him, and left it to another. Yet though Lord Lovelace joined the king, he treated his chaplain with great civility; but on his taking the field with the royal army, Mr Owen went to London, and soon afterwards joined the nonconformists. In the year 1642 he published his book entitled a Display of Arminianism, which laid the foundation of his future advancement. The committee for purging the church of scandalous ministers were so pleased with this work, that Mr White, their chairman, sent him a presentation to the living of Fordham in Essex; but after he had been there about a year and a half, the patron, hearing that the sequestered incumbent was dead, presented another to the living, upon which the Earl of Warwick gave Mr Owen the living of Coggeshal. He had not, however, been long at that town before he left the Presbyterians, and, joining the Independents, formed a church there. He was sent for several times to preach before the parliament, particularly on the 28th of February 1648–49, the day of humiliation for the intended expedition to Ireland. Cromwell, who was present at this last discourse, and had never heard him before, was so extremely pleased with it that he desired the preacher to accompany him into Ireland, at the same time offering to provide him with a residence in the College of Dublin. Mr Owen accepted the offer, but returned in about half a year. Soon afterwards Cromwell sent him into Scotland, but he also returned from thence after about half a year's residence at Edinburgh. He was then promoted to the deanery of Christ-Church, Oxford, whither he went in 1651; and Cromwell, being now chancellor of the university, nominated him his vice-chancellor. The next year he was created doctor of divinity by diploma. Dr Owen held the post of vice-chancellor five years, during which he behaved with the greatest moderation; for, although often solicited, he never molested the meeting of the royalists at the house of Dr Willis the physician, where divine service was performed according to the liturgy of the Church of England; and though he was a commissioner for ejecting scandalous ministers, he frequently overruled his brethren in favour of those royalists who were distinguished by their merit. At the death of Cromwell he was removed from the vice-chancellorship; and at the Restoration he was ejected from his deanery of Christ-Church. But he had provided himself a comfortable retreat at an estate he had purchased at Hadham. He now employed himself in preaching as often as he had an opportunity, and in writing books; one of which, entitled *Fiat Lux*, falling into the hands of Lord Clarendon, he was so pleased with it, or from policy pretended to be so, that he sent for Dr Owen, and acknowledging the service he had done by it to the Protestant religion, offered to prefer him in the church if he would conform; but he respectfully desired to be excused. His moderation secured him respect from persons of opposite principles; and in the number of his friends were Dr Wilkins, bishop of Chester, and Dr Barlow, bishop of London. He died at Ealing in 1683. His works are printed in seven volumes folio.

OWHYHEE, the easternmost, and by far the largest, of the Sandwich Islands. See the article POLYNESIA.

OWLAH, a city of Hindustan, in the province of Delhi and district of Bareilly. It is pleasantly situated on the western bank of the Harowly River, and, with the adjoining district, came into the possession of the British in 1802. It is an ancient town, and was fixed upon in the early part of the last century by Aly Mohammed, one of the Rohilla chiefs, as the capital of his territories. On his death Owlah fell to the share of Futteh Khan, superintendent of the household, and after the death of the latter his son Ahmed Khan resided there. It was also the residence of many of the chiefs and their families, which conduced greatly to its grandeur and extent. But on the cruel extermination of the Rohilla nation by Sujah ud Dowlah, aided by the British, in 1774, it was forsaken by its principal inhabitants; and it has now fallen into decay and ruin. It is about sixteen miles north-west from the town of Bareilly. Long. 79. 35. E. Lat. 28. 10. N.

OWLING, so called from its being usually carried on in the night, is the offence of transporting wool or sheep out of this kingdom, to the detriment of one of its staple manufactures.

OWRAM, NORTH, a township in the parish of Halifax, in the west riding of Yorkshire, 197 miles from London, where the inhabitants are chiefly employed in making woollen goods. In 1801 the population amounted to 4887, in 1811 to 5306, in 1821 to 6841, and in 1831 to 10,184.

OWRAM, *South*, a township in the parish of Halifax, only half a mile distant from North Outram, and, like it, chiefly occupied in the woollen manufacture. In 1801 the population amounted to 3148, in 1811 to 3615, in 1821 to 4256, and in 1831 to 5751.

OXFORD, the capital of the English county of the same name, is situated at the junction of the river Cherwell with the Isis, which about eight miles lower down receives the waters of the Thame, and then becomes the Thames, a contraction of Thame-Isis. It is fifty-five miles from London by the High Wycombe road, and fifty-eight by Henley. It is pleasantly situated on ground rising gently from the rivers which almost surround it, and its immediate vicinity smiles with fertile and verdant meadows; beyond which, on the east, south, and west sides, it is bounded by an amphitheatre of hills, and on the north the view is extended over a rich district in the highest state of cultivation. The air is pure and salubrious; and from the neighbouring heights, the city, with its spires, and domes, and towers, presents an impressive spectacle of all that is lovely in nature, magnificent in art, and sacred in antiquity.

The locality of Oxford is favourable for intercourse with the whole of the kingdom. It is nearly in the centre of England; and good lines of road pass through it from almost every quarter. Its vicinity supplies most of the first necessaries of life with facility; and though formerly the enormous price of fuel was the subject of serious complaint, that evil has been remedied by a canal which joins the Grand Junction Canal at Braunston, in Northamptonshire, and has proved a great advantage to the city, by conveying the coals of Staffordshire at a cheap rate, whilst the capital expended in the undertaking has become a very lucrative investment to those who embarked money in the project. Besides the canal, Oxford has water communication by the river Thames with both sides of the kingdom. The Thames and Severn Canal unites these two rivers through the Strond Canal, and thus goods may be conveyed downwards to Oxford from Bristol, Gloucester, Worcester, and Birmingham, and upwards from the mouth of the Thames near the metropolis of the empire.

The city, properly so called, was formerly surrounded by walls, considerable portions of which still remain. It is of an oval form, and about two miles in circumference. The municipal limits, which are now made co-extensive with the parliamentary boundary, comprehends the whole or part of twenty parishes, the extreme extent of the borough each way being now about three miles. Four principal streets, broad and well built, cross each other at the centre; but the communications between these streets are rather narrow. The High Street is generally admired, as well for its length as for the number and the magnificence of the buildings on both sides of it; the effect of which is much heightened by its curvature, which at every advance opens up new views of architectural grandeur. In this street is the entrance to the market, which is well stored with provisions of every kind, equal in quality to any in the kingdom. The town-hall is a fine building, serving the purpose which its name expresses, as well as that of a county-hall; and the assizes, the county-sessions, the election for city and county members, as well as public meetings, are held in it. It was built in 1754, at the expense of Mr Rowney, then member for the city; but has been since considerably improved by the united funds of the county and the city. It is one hundred and thirty-five feet in length by thirty-two feet in breadth, and is the apartment in which, in the year 1814, the freedom of the city was presented to George IV., the emperor of Russia, the king of Prussia, and many other distinguished personages. Adjoining to this edifice is the council-chamber, for meetings of the city council, which is adorned with portraits of eminent persons and benefactors. The corporation now consists of a mayor, ten aldermen, and thirty councillors, with a recorder, and justices of the peace appointed by the crown. The city returns two members to the House of Commons. These, before the Reform Act, were elected by the freemen; but the ten-pound householders are now added to them. Oxford is a county of itself. The county-jail, a large building, was erected upon the site of the ancient castle about thirty years ago; but, besides the county-jail, there is a city prison and a bridewell. The remains of the original tower of the fortress, and a large magazine for storing provisions for the garrison, are still preserved.

Some have pretended to trace the origin of Oxford to remote antiquity; but their speculations can only be looked upon as fanciful conjectures. No credit can be given to any statement respecting it previous to the reign of Alfred. In 727, a monastery was founded at Oxford, or, as it was originally called, Oxenford, dedicated to the Holy Trinity. The habitations of the laity attracted to the neighbourhood were probably the origin of the town; and as the clergy, previous to the Conquest, were the sole depositories of learning, and the only teachers to whom the people could look for instruction, and as every monastery became more or less a kind of school, it is not improbable that the educational department of the monastery was the germ of the University of Oxford.

In the course of thirty years, between 979 and 1009, the town was thrice consumed by fire; and during the contests between the Danes and Saxons, it often suffered severely. It was the occasional residence of King Edmund, surnamed Ironside, who was murdered there; of Canute the Great, who repeatedly held parliaments in it; and of Harold, surnamed Harefoot, who was crowned and died in Oxford.

The inhabitants having refused to open their gates to William the Conqueror, he obtained entrance by force, and levied a heavy tax on the townsmen as a punishment for their resistance; and the better to restrain their rebellious spirit, he built and fortified a strong castle on the west side of the town, near the river.

The successors of the Conqueror frequently made Oxford the place of their residence, and several of them were munificent patrons of its schools. In the contest between King Stephen and the Empress Maud, the latter, having taken shelter in the castle, was besieged in it by the king in person, and only escaped by stratagem the day before it surrendered.

In 1177, the princes and chief lords of Wales did homage here for their territories and estates to Henry II. This monarch resided, during a great part of his reign, in the palace of Beaumont, which was built in the north suburbs by Henry I. In this palace Richard Cœur-de-Lion was born; and here King John passed many of his troubled hours. Richard I. was a great promoter of learning, and gave especial encouragement to Oxford, which was the place of his birth. Many new halls or schools were established under his patronage, and by means of funds furnished from his private exchequer. To such a pitch had he raised the reputation of Oxford, that in the succeeding reign its schools were attended by not less than three thousand students; but in the year 1209 this prosperity was sadly overcast, and the town, as a seat of education, threatened with total destruction. A student, whilst engaged in some manual exercise, accidentally killed a woman belonging to the town, and, being alarmed for the consequences, took to flight. The mayor and burgesses surrounded the hall to which the supposed murderer belonged, and demanded that he should be delivered up. They were informed that the accused student had fled; but this answer by no means appeased the clamours of the multitude, who seized three students, entirely unconnected with the affair, and hanged them without trial or inquiry. The teachers and scholars, justly enraged at this barbarous outrage, unanimously quitted Oxford, and betook themselves to Cambridge and other places; and they did not return till the humbled inhabitants had repeatedly applied for pardon, and expressed the deepest contrition for their conduct.

In the reign of Henry VIII. Oxford was elevated to the rank of a city, and that of a bishop's see; and it was at Oxford that Archbishop Cranmer, and Bishops Ridley and Latimer, were executed as heretics, by order of Queen Mary, in October 1555.

In the year 1577, the plague raged with dreadful mortality in the town. During the trial of a popish bookseller, accused of circulating mischievous pamphlets, nearly all the persons present were suddenly seized with sickness; and within forty hours upwards of three hundred died, amongst whom were the chief baron, the high sheriff, several justices of the peace, and most of the jurors. When the plague broke out in London, King James withdrew to this city for safety; but the dreadful scourge visited Oxford not long afterwards, and made such awful devastation that the scholars fled from the University, and the citizens shut up their shops; and not a living creature, besides nurses and corpse-bearers, was to be seen in the streets, which were covered with grass, even in the market-place.

During the struggles between Charles I. and his parliament, the king, in consequence of the disaffection of the citizens of London, removed his court to Oxford; being well assured of the loyalty of the townsmen, and the inviolable allegiance of the university. The melancholy winter of the year 1646 was spent by the unfortunate monarch within the walls of Christ-Church; where he assembled a parliament of his diminished and disheartened adherents, and where he wrote his memorable letter to Lord Digby, in which he declared, "if I cannot live as a king, I will die as a gentleman." Though the city was strongly fortified, and considered as a post of great importance by both parties, it never happened, during the war, to be the scene of any great military transaction; but the negotiations for peace between Charles and the republican party were chiefly carried on at Oxford.

The last parliament which met in this city was convened by Charles II. in 1681, and lasted only seven days. The party spirit and turbulence displayed, not only by the populace, but by the representatives, compelled the king to order its premature dissolution, to prevent the passing of a bill for banishing and excluding from the throne his brother, the Duke of York, afterwards James II.

Oxford has the transcendent glory of being the cradle of the Reformation. Wickliffe, whose name will be venerated by all who value the truths of Christianity, and the progress of the human mind, was warden of Canterbury College; and it was here that he read those lectures on divinity which shook to its foundation that spiritual despotism which held Europe in thraldom, and here he first inculcated those truths which form the basis of religious liberty.

The University contains twenty colleges and five halls.

Merton College, the oldest in point of legal establishment, was founded by Walter de Merton, bishop of Rochester, who established it by charter, dated 7th January 1264. It consists of three courts. The chapel, which is situated at the west end of the outer court, is a fine specimen of old English architecture. The tower and gate of the outer court were constructed in the early part of the fifteenth century; and the whole of the other part was rebuilt in 1589. The second, or large inner court, exhibits a mixed style of architecture; the third, or small court, is the oldest, and is supposed to have been built at the same time with the library, which forms its south and west sides. This is the oldest library in the University, and possesses many valuable manuscripts and early printed books. In the hall of this college Queen Elizabeth was entertained at dinner on her visit to the University in 1592.

University College is said to have owed its origin to King Alfred; but it is ascertained that it was founded by the University, with funds left by William of Durham, in 1249. It stands on the south side of the High Street, and consists of two quadrangular courts, which were built at various times between the years 1634 and 1675.

Baliol College was projected by John de Baliol, father of the unfortunate king of Scotland, in 1263; but, in consequence of his sudden death, it was only founded in 1282, by his widow, Dervorguilla. The architecture is very irregular; none of the present buildings are of earlier date than the fifteenth, and the east and south-east sides were rebuilt in the beginning of the eighteenth century. The court of the quadrangle is one hundred and twenty feet by eighty; there is also belonging to the college an area on the north-west, containing lodgings for the students, and a new building fronting the street one hundred and eight feet in length.

Exeter College was founded in 1315, by Walter de Stapleton, bishop of Exeter. It has been built at various times, and forms one extensive quadrangle, nearly a hundred and thirty-five feet square. The architecture of this College is of an uniform and simple character. The whole of the west front has recently been renewed with Bath stone, and a handsome new building erected, facing Broad Street.

Oriel College was founded in 1326, by Adam de Brom; and shortly after was taken under the protection of Edward II. It consists of a quadrangular range of buildings, with two ranges on the east and west sides of the garden, between which is the library, an elegant modern building, from a design by Wyatt.

Queen's College was founded by Robert de Eglesfeld, and obtained a charter from Edward III., dated the 18th January 1340. The present buildings are of modern erection; they consist of two courts, divided by the hall and chapel, in an oblong form, three hundred feet in length by two hundred and twenty in breadth. The library, which contains about 18,000 volumes, is a magnificent room, a hundred and twenty-three feet by thirty.

New College. The foundation-stone of this college was laid by William of Wykeham, for his scholars of Winchester College, in the year 1380; but the buildings were not completed till 1386. As originally projected by the founder, they consist of a spacious quadrangle, including the chapel, hall, and library. A range of cloisters, extending a hundred and forty-six feet by a hundred and five, with the area within, were consecrated in 1400, as a burial-place for the college. The chapel is one of the finest buildings in the University, and is exceedingly beautiful and chaste in its interior decorations.

Lincoln College was founded by Richard Fleming, bishop of Lincoln, in 1427, and completed by Bishop Rotherham. The chief buildings compose two quadrangular courts. The larger, which contains the library and hall, was built soon after the founder's death; but the smaller, in which is situated the chapel, whose old painted glass windows are the finest in Oxford, was not built till two centuries afterwards.

All-Souls College was founded in 1437, by Archbishop Chicele. It consists of two spacious courts, the one opening into the High Street, and the other into the court where the Radcliffe Library is situated. The latter quadrangle, which was erected in the beginning of last century, is a hundred and seventy-two feet in length by a hundred and fifty-five in breadth; the buildings are in the mixed Gothic style of architecture, and very handsome. On the south side is a beautiful chapel, with an altar-piece by Raphael Mengs. The library, which is on the south side, is a hundred and ninety-eight feet in length by thirty-two and a quarter in breadth, and forty feet in height, and contains above 110,000 volumes.

Magdalene College was founded by William of Waynflete, bishop of Winchester, under a license dated the 18th July 1457. It is situated on the east side of the city, near the Cherwell, and is one of the finest ranges of buildings in the University. On the side fronting the High Street there is a finely-proportioned tower, a hundred and forty-five feet in height. The chapel is a beautiful Gothic structure, which has recently been restored, in good taste. Magdalene College being bound by its statute to entertain the kings of England and their sons when at Oxford, it has frequently been the scene of royal festivity. Edward IV. and Richard III. were both entertained here by the founder. Prince Arthur paid a visit to this college in 1496; and in 1605 James I. held his court within its walls, on which occasion Henry prince of Wales was admitted a member of the society. In 1649, Oliver Cromwell, Fairfax, and other officers of the parliamentary army, had a sumptuous dinner provided for them here, and afterwards played at bowls in the college green.

Brazen-Nose College was founded by William Smyth, bishop of Lincoln, in concert with his friend Sir Richard Sutton. The buildings were begun in 1509, and occupied the site of several halls, amongst which was Brazen-Nose Hall, whence the new foundation derived its name. It consists of an extensive quadrangle, a smaller court on the south, a range of buildings called the New Buildings, and the principal's lodgings. The front of this college forms the west side of Radcliffe Square.

Corpus Christi College was founded and endowed in the year 1516, by Richard Fox, bishop of Winchester. The building, which stands to the east of Christ-Church, originally consisted of one large quadrangle, with a chapel, hall, and library; but various additions have since been made. The altar-piece in the chapel is the Nativity by Rubens. The library contains some curious printed books and manuscripts.

Christ-Church College is indebted for its origin to the munificence of Cardinal Wolsey, who commenced it in 1524, under the designation of Cardinal College, upon a scale of magnificence far surpassing that of any of the other founders; but upon his disgrace Henry VIII. seized the revenues. In 1532 Henry was induced to grant the college a charter, and directed that it should be called King Henry VIII.'s College; but about twelve or thirteen years afterwards Henry converted the college into a cathedral church, translating to Oxford the episcopal see of Oseney; and thus it became an ecclesiastical endowment, with a foundation for children annexed to it. Besides the cathedral, the buildings consist of two spacious quadrangles, with two smaller courts; and in the tower, which rises from the gateway in the centre of the principal front, is suspended the bell called "Great Tom." The cathedral is supposed to have been completed about 1180, but parts of it are of much earlier date. The hall built by Wolsey, with its roof of richly carved oak, ornamented with the armorial bearings of Wolsey and Henry VIII., is a fine specimen of his magnificent taste.

Trinity College was founded in 1554, by Sir Thomas Pope, who purchased for this purpose the extensive buildings of Durham College. This college formerly consisted chiefly of a low quadrangle, with hall, library, and chapel. In 1664, extensive additions were made, and soon afterwards a new court of three sides was built by Sir Christopher Wren.

St John's College was founded and endowed in 1557, by Sir Thomas White, a citizen and merchant of London. It consists of two quadrangles, and has in front a wide terrace and a row of lofty elms. The inner court was built in 1635, from a design by Inigo Jones.

Jesus College owes its foundation to Dr Hugh ap Rice, or Price. Queen Elizabeth instituted the establishment by charter, dated the 27th June 1571; but though nominally foundress, she bestowed little patronage, and still less property, on the college, the funds having been supplied by Dr Price and the munificence of other individuals. The buildings form two quadrangles, the first measuring ninety feet by seventy, and the second a hundred by ninety. The front towards the street was rebuilt in 1756.

Wadham College was projected by Nicholas Wadham; but dying before his plan could be put in execution, his widow founded it in 1613. It consists of one quadrangle about a hundred and thirty feet square. The hall is one of the largest in the University. The Royal Society originated in this college, and its meetings were held in a room over the gateway, from 1652 to 1659.

Pembroke College. Though in the charter, which is dated 1624, King James is called founder, and the Earl of Pembroke the chancellor of the University, yet they contributed little or nothing towards the establishment of this college; the real founders were Thomas Tesdale and Richard Wightwick. It consists of a small neat quadrangle; and the chapel attached to it, which was erected in 1728, is an elegant building of the Ionic order.

Worcester College was founded in 1714, under the will of Sir Thomas Cooks. It is situated upon the western side of the city, near the banks of the Isis. It consists of a range of buildings, having the library, hall, and chapel in the centre, an elegant line of new buildings on the north, and the old buildings on the south side.

Hertford College, anciently Hart Hall, was elevated to the rank of an independent college in the year 1740; but since 1805 no principal could be elected, owing to the nature of the statutes. It has now ceased to exist as a college. The site is occupied, under an act of parliament passed in 1816, by St Mary Magdalene Hall.

The halls were originally the private property of inhabitants of the town, who let them for the use of the students; but after the endowment of colleges, the halls gradually fell into disuse. Five, however, still remain, and the students who belong to them wear the same dress, and have the same university privileges, as the other students; but the halls have no fellowships or scholarships, and whatever property they possess is held in trust by the University. The names of the halls are St Mary's, Magdalene, New Inn, St Alban's, and St Edmund's. There is nothing in their architecture worthy of remark.

The Bodleian, or Public Library, was founded by Sir Thomas Bodley, at the close of the sixteenth century, on the remains of that which was originally established by the Duke of Gloucester. The erection of the present building was begun in 1610. The principal room is in the form of the letter H. The Bodleian is one of the five libraries which, according to act of parliament, receives a copy of every newly-published book. The continual accessions which it has received have rendered it one of the best libraries in Europe. The library is open between Ladyday and Michaelmas from nine in the morning till four in the afternoon, and between Michaelmas and Ladyday from ten in the morning till three in the afternoon. No book can be taken out of the library; and from the illiberal nature of the regulations, it is of little use, even to the resident members of the University. The Arundel Marbles are placed in an apartment on the north side of the schools.

The Radcliffe Library is one of the most imposing architectural ornaments of the University. It was founded by Dr Radcliffe, who bequeathed L.40,000 for its erection; and the building was executed by Gibbs between the years 1737 and 1749.

The Clarendon Printing-house was erected in 1711, from the profits arising out of the sale of Lord Clarendon's History of the Rebellion, the copyright of which was presented to the university by his lordship's son. It is a massive structure, two stories high. The business of printing for the university was carried on in this building till 1830, when it was removed to the present printing-house, which was commenced in 1826, and ready for use in the following year.

The Theatre was built by Gilbert Sheldon, archbishop of Canterbury, and chancellor of the University in 1669, on the plan of the Theatre of Marcellus at Rome; and the architect was Sir Christopher Wren. It is used for public meetings, for the recital of prize compositions, and occasionally for conferring degrees.

A museum was founded in 1682, by Elias Ashmole. At the extremity of the northern suburbs stands the Observatory; and at the entrance of the city by the London road are the Physic Gardens, which were commenced in 1622 by the Earl of Derby.

When Henry VIII. elevated Oxford to the rank of a bishop's see, he converted the ancient church of St Frideswide into the cathedral. It is built in the form of a cross, with a spire in the middle; and the tower contains ten bells, which formerly belonged to Oseney Abbey. The length of the chapel from east to west is a hundred and fifty-four feet. The nave was originally almost double its present length, but was in part taken down by Cardinal Wolsey, to make room for the dwellings of the canons. The length of the transept from north to south is a hundred and two feet. The height of the western part is forty-one feet, and of the choir thirty-seven feet. This building contains monuments of great antiquity. Most of the windows were destroyed in 1651; those that remain, with others since executed, display some historical scenes connected with sacred subjects. It has of late years been thoroughly repaired, and has recently been adorned by a fine statue of Dr Cyril Jackson, long president of the college. It was executed by Chantrey, and is universally allowed to be an admirable likeness.

In noticing the parochial churches of the city, the first to be mentioned is that of St Mary, which, though the public service is partly conducted under the direction of the University, and it is hence called the University Church, does in fact belong to the vicar and the inhabitants of the parish. It is a spacious Gothic structure, finished in the year 1498. The lofty spire, a hundred and eighty feet in height, is a conspicuous object, and the tower contains six large and well-toned bells. In 1828 it was repaired and very highly finished, but in harmony with the original plan.

There are thirteen other parish churches. St Peter's-in-the-East is an interesting edifice, of a very ancient date; and is supposed to have been originally built by St Grymbald, under the patronage of Alfred. St Michael's is of equal dimensions with St Mary Magdalene's, and is said to have belonged to the canons of St Frideswide, before the Norman conquest. The windows are large and pointed. St Martin's, or, as it is more commonly called, Carfax, is the church of the city, at which the mayor and corporation attend divine service. It has been rebuilt within the last fifteen years, upon the site of a structure of great antiquity, and much enlarged. St Peter's-in-the-Bailey, at the west end of the city, was opened for divine service in 1740, and a gallery added to it thirteen years after, at the expense of an individual named Flexney. It is seventy feet in length and thirty-eight in breadth, with a tower containing only two bells. St Aldate's, of great antiquity, is said to have been founded or restored in 1004. It is a venerable pile, consisting of a nave, two aisles, and a chancel, and is about a hundred feet in length. St Ebbe's is a plain, modern church, built in 1817. The church of St Mary Magdalene is a neat stone edifice, eighty-eight feet in length, said to have been founded in 1194, and is remarkable for three uniform pointed windows in a chantry chapel within it, and a parapet of open trefoil work of great beauty. St Giles is an edifice venerable from its age, being furnished with numerous lancet-shaped windows. It is a solid and capacious building, though not sufficiently so for the population of the parish, which has rapidly increased. Holywell Church, so named from a well of great sanctity in ancient times, and near to it, is a small building, with a tower

Oxfordshire.

said to have been built in 1464; but the church itself is much more ancient. It has an embattled tower, containing six bells. St Clement's, in the eastern suburb, is a handsome edifice, lately enlarged, owing to the great increase of inhabitants. St Thomas's Church, at the western extremity of the city, was founded by the canons of Oseney in 1141. It is about a hundred feet in length, and has lately been much improved. The church or chapel of St John is also the chapel of Merton College; but the parishioners have a part of the north side allotted to them as the place of sepulture, the chaplain of the college reading the burial service. There is also the church of All Saints, in the High Street. Besides these parish churches, there are four places of worship for Protestant dissenters and Wesleyans, and a small but neat chapel for the Roman Catholics. The population amounted in 1801 to 10,534, in 1811 to 11,916, in 1821 to 14,901, in 1831 to 18,436, and in 1833 to 20,411. This does not include those persons resident in the several public buildings comprehended in the University, or in the House of Industry, or the Radcliffe Infirmary. The census is taken at a period of the year when the colleges are not at the fullest, and the absent students, fellows, and professors, are consequently included in the enumerations of other districts. The whole number residing in the university amounted in 1801 to 1171, in 1811 to 1015, in 1821 to 1463, and in 1831 to 1634. The residents in the House of Industry were 219, and those in the Radcliffe Infirmary 145; thus making the whole population at the census of 1831 to be 22,186. The system of education taught in the colleges will be treated of under the article UNIVERSITIES.

OXFORDSHIRE, an inland county of England, chiefly celebrated on account of its capital, which is one of the principal seats of learning in the British dominions, and from which city it has derived its name. It is bounded on the east by Buckinghamshire; on the south, south-west, and south-east by Berkshire; on the north-east by Northamptonshire; and on the north-west by the county of Warwick. The river Thames (called sometimes the Isis till it reaches Oxford) is the line of demarcation on the whole of its southern boundary; running between this county and Berkshire with various, and, in the latter part of its course, most beautiful sinuosities. The county is of a most irregular figure. Near the centre, in which the city of Oxford stands, it is not more than seven miles in breadth, and at no great distance to the north it is thirty-eight miles. Towards the north it resembles a cone, and to the south it is similarly contracted. Its extreme length is fifty miles. The extent is estimated at 742 square miles, or 474,880 English acres. It contains one city, twelve market-towns, and 207 parishes, and is divided into fourteen hundreds.

This county is by no means uniformly beautiful. On the north, the absence of hedges, which are supplied by stone walls, gives a dreary appearance to the face of the country. In the centre it is generally flat and woody, affording few pleasant prospects, though its trees and verdure give it the semblance of wealth. The southern part, from the beauty of its rivers, the gentle swelling of its hills, the verdant meadows between them, and the number of highly embellished residences of rich proprietors, is a district abounding with rural charms. The Chiltern Hills, the highest range in England south of the river Trent, belong to this portion. They are in many parts adorned with beech-woods, and in every interval of these woods cultivated quite to their summits.

The climate of the county varies according to the elevation and exposure. In the north, where no hedges impede the winter winds, the cold is somewhat severe; and the Chiltern Hills are frequently enveloped in damp fogs, especially in the more woody parts of them. Mr Arthur Young, in his Agricultural Survey of Oxfordshire, has formed a classification of the soils in the different districts of the county, which, like all similar estimates, must be received with hesitation, or at least with many exceptions. The red soil, found chiefly in the north, and by far the most fertile, he estimates at 79,635 acres. The land, provincially called *stone-brash*, found in the centre, and the surface of which is often covered with stones, amounts to 164,023 acres. The Chiltern lands, the soil of which is a loam resting everywhere on a bed of chalk, and covered with flint stones, are 64,778 acres. To these are added 166,400 acres under the description of miscellaneous, which comprehends all sorts of soil, from loose sand to the heaviest clay, and includes the rich meadows on the banks of the rivers.

Although this is wholly an agricultural county, and although much progress in improvement has been made of late years, yet the general practices are by no means equal to the average of those of the rest of England. The most beneficial husbandry is founded upon the valuable water-meadows on the banks of the different streams. These are naturally so fertile that they appear to have prevented that care which would render them still more productive. Little attention is paid to draining, and still less to irrigation; though the good effects of both these practices are obvious, and their accomplishment easy in many circumstances. Some few oxen are fattened, and butter and cheese made in the dairies, but the facility of navigation induces the farmers to make more hay than is consumed by their stock, and to send it to distant and higher markets than their own, nearer to the metropolis. On the arable fields, especially on the stony lands near Burford, the use of oxen for the plough is very common; and the Herefordshire breed is generally preferred for that purpose. The practice of paring and burning the surface prevails in many parts of the county; and in the newly enclosed lands the application of lime as a manure is highly beneficial; whilst on the Chiltern lands it is not found to produce a good effect equal to the expense which attends it.

Where the soils are so very various, the rotation of crops must necessarily vary with them. On the red soils, the most usual course is, 1st, turnips; 2d, barley, or spring-wheat; 3d, clover; 4th, wheat; 5th, peas or beans; and, 6th, oats. On the stone-brash lands, the usual rotation is, 1st, turnips; 2d, barley; 3d, clover, to stand for two years; 4th, wheat; and, 5th, oats, peas, or sometimes, but rarely, beans. On the Chiltern lands the rotations are the same, with only slight variations. On both these last tracts of country, the cultivation of sainfoin is very extensive; occupying on most farms from one seventh to one eighth of the whole. This valuable artificial grass produces heavy crops. When it was first introduced, it would remain productive for fifteen or sixteen years; but since it has become more familiarized to the soil, it seldom lasts more than seven years so as to be fit to make hay, but yields food for sheep for one or two years afterwards. The sheep, which were formerly almost all of the Berkshire breed, have of late years been superseded by the race of the South Downs.

Oxfordshire is not a manufacturing district. Witney was long celebrated for its blankets, and still retains its fame; but, in spite of the machinery which has been introduced to diminish the price, the manufacturers of Yorkshire and Lancashire excel those produced here. At present, however, this trade gives employment to 270 persons in the town and two adjoining hamlets. At Banbury, and its adjacent hamlet Neithrop, 125 persons are occupied in making plushes and girth-webs, and a number in some other parishes within the county. Gloves of a superior kind are made at Woodstock and its vicinity; and there are some of the finer kinds of cutlery made in that town. Sacking is made at Abingdon and at Henley; and many axles and coach-wheels at Henley-on-Thames.

The rivers all discharge themselves into the Thames. They are formed by the numerous small springs which are everywhere to be seen; and before they join the Thames, are called the Windrush, coming from Burford and Witney; the Evenlode, from Wichwood and Charlbury; and the Cherwell, from the vicinity of Banbury. The Thames, composed of the stream of that name and the Isis (on which a strange confusion has arisen), is navigable from near one of its sources, not far from Leachlade, to the sea. The barges navigating it are from seventy-five to one hundred tons burden, but the larger ones ascend no higher than Oxford. From the frequent recurrence of shoals, owing to the floods in winter, and the scarcity of water in summer, it is a dilatory navigation; so that frequently the passage from America to London occupies less time than from Leachlade to that city. The scarcity of fuel was severely experienced till within these last few years; but the completion of a canal which connects the city of Oxford with the collieries of Staffordshire has removed the evil, and proved highly profitable to the proprietors of that important work.

The city of Oxford, the glory of this county and of the kingdom, has already been described.

The antiquities of this county have been accurately described, and are deserving of the closest inspection. Amongst them are traces of the various roads formed by the Romans, whose principal station was at Dorchester; besides many funereal mounds, and the Vallum, called the Devil's Ditch. The Priory of Godstow, and the ruins of many other religious houses, exhibit the architecture of different and remote ages.

The population of this county, according to the returns at the four decennial enumerations, has been as follows, viz. in 1801, 109,620; in 1811, 119,191; in 1821, 136,971; and in 1831, 152,100.

The occupiers of land employing labourers were	2054
Occupiers of land not employing labourers	458
Labourers employed in agriculture	15,998
Labourers employed in manufactures	711
Labourers employed in retail trade or handicraft	11,110
Capitalists, bankers, &c	2,254
Labourers not agricultural	3,049
Other males under twenty years of age	2,547
Male servants	1,223
Female servants	5,571

The towns within this county which contain more than 1000 inhabitants are the following:

Oxford	20,640	inhabitants.
Banbury	5,906	...
Witney	5,336	...
Henley-on-Thames	3,618	...
Bicester	2,868	...
Thame	2,885	...
Chipping Norton	2,637	...
Burford	1,866	...
Watlington	1,833	...
Bampton	1,605	...
Deddington	1,590	...
Woodstock	1,380	...

The whole county is in the diocese of its chief city. The members returned to the House of Commons under the new law are, three for the county, who are polled for at Oxford, Witney, Deddington, and Nettlebed; two each for the city and for the university of Oxford; and one each for the boroughs of Banbury and Woodstock.

The most distinguished residences are, Blenheim Castle, Duke of Marlborough; Blandford House, Duke of Beaufort; Brightwell, W. Lowndes Stowe, Esq.; Cuddesdon Palace, Bishop of Oxford; Crowsley Park, John Atkins Wright, Esq.; Ditchley Park, Lord Dillon; Grey's Court, Lady Stapleton; Heythorp, Earl of Shrewsbury; Kirtlington Park, Sir H. W. Dashwood; Middleton Stoney, Earl of Jersey; Mongewell, Bishop of Durham; Mapledurham, Michael Blount, Esq.; Nuneham Park, Lord Vernon; Rycot Park, Earl of Abingdon; Shiplake, Lord Mark Kerr; Shelswell, —— Harrison, Esq.; Shirburn Castle, Earl of Macclesfield; Thane Park, Miss Wykham; Wroxton, Earl of Guildford; Waterstock, W. H. Ashhurst, Esq.; Wormsley, John Fane, Esq.; Wheatfield, Lord Churchill.

(See the *Agricultural State of Oxfordshire*, by Arthur Young; Pott's *Oxfordshire;* and Brewer's Account of Oxfordshire, in the *Beauties of England and Wales.*)

Oxgang || Oxus.

OXGANG, or OXGATE, is generally taken, in our old law-books, for fifteen acres, or as much ground as a single ox can plough in a year.

OXUS, or AMMU. This great river of Central Asia has its source in the high lands of Pamer, a branch of the main ridge of the Hindu Coosh Mountains, which, extending northward, forms the boundary between Thibet and Great Bukharia. It issues from a glacier in a narrow valley 200 or 300 yards broad, which is enclosed on three sides by the high snowy mountain called Pooshtikhur. The stream is seen flowing from under the ice, which is stated to be at least forty spears in depth. The spring itself is buried under the great mass of ice whence it issues, and cannot be seen; but there is no doubt of its issuing from this spot, as there is no other open or break from which it could issue at any more distant point. The small but swelling stream is carried north in this narrow valley for five coss or ten miles; at eight miles it is twenty yards broad, and breast deep; and on leaving the valley, after being joined by many other springs from the same hill, it is fifty yards broad, and about four feet deep. It is joined by the Shiber about sixty miles from its source, which is sixty yards broad. The Oxus, however, is much broader, having been joined by seven or eight streams from knee to middle deep, and from ten to thirty yards broad. It flows in a south-west direction for 120 miles, and then meets a high ridge of mountains running from west-north-west to east-south-east. From this point it takes a west-south-west course through the wild and mountainous regions which separate the country of Balkh from Independent Tartary, until it breaks through the ridge in its progress southward, and meets some of the ridges which diverge from the main ridge of Hindu Coosh. In this part of its upper course, being a distance of more than 300 miles, it is confined between the mountains, and is joined by numerous streams, from two to four of which are crossed in each day's journey along its left or southern bank, besides two very considerable rivers, namely, the Soorkhab or Kurategeen River, and the Kokcha or Budukshan River. It also receives the tribute of many streams from the north, the names of which are unknown in Europe. Its course is now west-north-west; and it passes the far-famed city of Samarcand, which, however, is not situated on its banks, but on a river flowing into it. To Bukharia, which is situated on one of its tributary streams, it has a northerly course of 250 miles, being forced off in this direction by the high land of Hindu Coosh, which extends north of the ridge a considerable distance, and runs over a flat country, sandy, and little better than a desert. From this point to Ourgunge is a distance of 400 miles, over a desert of at least 300 miles, with only a few habitations of horse-breeders along the banks. On the left bank is a forest the greater part of the way, through which those who pass are obliged to carry their provisions for eight or ten days at a time. Mr Elphinstone has thus traced its course for 900 miles; and other travellers in the East have gleaned scanty information respecting its lower course till it terminates in the Sea of Aral after a course of 1200 miles. Frazer mentions, on the authority of a native traveller or merchant, that after passing the town of Ourgunge, it makes a turn to the east, and is joined by the Seer or Sihon (the Jaxartes), when both spread out into a large lake, which has no outlet, its waters being absorbed by the sand of which the surrounding country is composed. Frazer seems to think that this account corresponds so well with that of the Arabian and the Persian geographers, that there is no denying credit to it. But the accounts of native travellers are proverbially so erroneous, that no reliance can be placed upon them. They generally travel for the purposes of trade, and pay little attention to the geography of the country, or other details; and this, joined to their known carelessness of truth, renders their testimony of little value. Colonel Kinneir mentions, that Sir John Malcolm conversed with a native, who assured him that the termination of the river was in the Caspian Sea. This opinion is, however, strongly combated by Mr Frazer, who affirms that there is nothing like evidence to prove that the Oxus ever reached the Caspian Sea; that this notion rests on vague tradition, founded on ignorance; and that all the native authorities who speak directly to this point constantly say that the Jeyhoon or Ammu falls into the lake of Khaurezm. The ancient geographers were ignorant that there were two distinct lakes in Asia, namely, the Caspian Sea, and that of Aral. They supposed that both formed one lake; and hence their error was extremely natural, in giving a termination to the Oxus in the Caspian, the only outlet which they knew to exist in the direction of its stream. But we know for certain that no river falls into the Caspian to the south of the bay of Mangulshuck; for the caravans that pass and repass from Astrabad to Khyvah, and from thence to Mangulshuck, do not cross a single stream, or meet with a drop of running fresh water, after crossing the river Attruck near Astrabad. It is equally certain, from the same evidence, that no branch of the Oxus falls into the Caspian to the northward of Mangulshuck. Mr Frazer, in answer to his inquiries concerning the rise of the Oxus or Ammu, was informed by a traveller who saw it in the summer season near Balkh, that it was as large as the Jumna in its fullest season, and perfectly navigable for boats, which are in common use for crossing the stream, and for the conveyance both of goods and passengers from Balkh and from Bukharia to Ourgunge and Khyvah. At Bukharia it is a very large river, the stream being at no time less than a thousand yards wide; and in summer, when the snow melts, it sometimes spreads to the breadth of four miles. It is deep, and navigable for boats, by which means an active intercourse is maintained in most parts of its course. (F.)

OXYCRATE, an old term in *Pharmacy*, denoting a mixture of vinegar and water, proper to assuage, cool, and refresh. The usual proportion is one spoonful of vinegar to five or six spoonfuls of water.

OXYDE, or OXIDE, in *Chemistry*, is the term employed to denote a very numerous class of bodies formed by the union of certain bases with a smaller proportion of oxygen than what is necessary for their conversion into acids. See CHEMISTRY.

OXYDATION, or OXIDATION, is a term employed to express the process by which bodies are converted into oxides. See CHEMISTRY.

OXYGEN, a term adopted in the chemical nomenclature to express the acidifying principle, and formed from ὀξυς, *acid*, and γινομαι, *to generate*. It is not found naturally in a separate state, but always in combination with some other substance. In its aëriform or elastic state it is called oxygenous gas, and is the same as the dephlogisticated air of Priestley and Cavendish, the empyreal air of Scheele, and the vital or pure air of other chemists. See CHEMISTRY.

OYER, in law-books, seems to have been anciently used for what is now called *assizes*. See ASSIZE.

OYES, a corruption of the French OYEZ, *Hear ye*; a term or formula frequently used by the criers in our courts on making proclamations, or to enjoin silence.

OYOLA, one of the larger Navigators' Islands, in the South Pacific Ocean, separated from Maouna or Massacre Island by a strait nine miles wide. It is mountainous towards the centre, from which the land slopes with a gentle declivity to the sea. Long. 171. 25. W. Lat. 14. S.

OYSTER HARBOUR, a bay on the south-west coast of New Holland, and north part of King George the Third's Sound, discovered by Vancouver in 1791. Long. 118. 15. E. Lat. 34. 58. S.

OYSTER *Island*, an island situated in the Bay of Bengal, and extremely dangerous to vessels, as it rises very little above the level of the sea, and is surrounded by rocks. It abounds with small rock-oysters, which the natives of the opposite coast catch with hammers and carry to Chittagong, whence they are conveyed to Dacca and Calcutta. It is nine miles south-south-west of the north point of the Arracan River.

OZANAM, JAMES, a laborious mathematician, was born in the year 1640, at Bouligneux, in the principality of Dombes. His family was of Hebrew extraction, but had long been converts to the Catholic faith; and some of them had held considerable places in the parliament of Provence. Nature had given him a decided taste for the exact sciences; but his father, who intended him for the church, took care not to foster an inclination adverse to his views; and, during four years, young Ozanam studied divinity, though with little pleasure or success. As he advanced in years, his aversion to this study increased in the same proportion as his ardour for the sciences, to which he was denied access, became more and more intense. His father, however, died just as he was about to complete his course of theology; and being now his own master, he renounced all idea of entering the church, and, devoting himself entirely to the mathematics, made so great progress that, at the age of fifteen, he composed a work in which he afterwards found some things deserving of publication. As, by the custom of Bresse, the estate went to the eldest son, the subject of this notice had no other resource than to teach mathematics, which he had not been permitted to study; and, accordingly, having established himself at Lyons, he there supported himself for some time by the produce of his lessons, supplying the deficiency by his gains at play. Some foreigners, pupils of his, to whom he had lent fifty pistoles without taking any note or obligation for repayment, having mentioned the circumstance to the father of Chancellor d'Aguesseau, that magistrate, touched with so generous a trait of character, invited Ozanam to come to Paris, where he would necessarily find greater facilities for teaching than at Lyons. Ozanam accepted this proposition the more readily, because he desired above all things to make the acquaintance of the great geometers whose works he had studied; and having abandoned play in order to devote himself entirely to the mathematics, he had soon a great number of pupils. But at first he wanted the prudence necessary to profit by his success. He was young, handsome, and sprightly, and being addicted to gallantry, he became entangled in some intrigues which, besides the annoyance they gave him, exposed him to considerable ridicule. Reflection followed, and celibacy appearing to him a dangerous state, he married a young woman almost without fortune, who had interested him by an air of gentleness, modesty, and virtue. Nor, adds Fontenelle, did these fair appearances deceive him. Satisfied with his condition, he divided his time between study and teaching. He gave lessons during peace; and the time of war he employed in composing works which added to his ease and comfort as well as to his reputation. He had as many as twelve children, who nearly all died at an early age, and whom he regretted, says his panegyrist, "comme s'il eût été riche, ou plutôt comme ne l'étant point; car ce sont les plus riches qui se tiennent les plus incommodés d'une nombreuse famille." He lost his wife in 1701, and with her all the comfort and happiness of his life. Neither did this misfortune come single. The war of the succession, by depriving him of his scholars, reduced him to a melancholy condition. But his patience was never for an instant ruffled, and notwithstanding the difficulties in which he found himself involved, he lost nothing of his gaiety. About this time he was admitted into the Academy of Sciences as an *élève*, a title which it was intended to elevate in general estimation by bestowing it on a man of Ozanam's age and merit. He appears to have had a presentiment of approaching death, arising perhaps from some latent disorder within; and under this impression he refused to receive some foreign noblemen who wished to become his pupils, alleging that he should not live long enough to carry them through a regular course. At length, on the 3d of April 1717, immediately after dinner, which he had eaten with some relish, he felt himself unwell, and asked to be put to bed; but a few minutes afterwards he was struck with an apoplexy, which in less than two hours carried him off. Ozanam was a man of a mild and calm disposition, of a cheerful and pleasant temper, and endeared by a generosity almost unparalleled. After marriage his manners were irreproachable. He was sincerely pious, although in matters of religion he did not allow himself to know more than the people, and studiously avoided intermeddling in theological disputes. He used to say that it was the business of the doctors of the Sorbonne to dispute, of the pope to decide, and of a mathematician to go to paradise in a perpendicular line. He composed with extreme facility, and never made any erasure or correction on his manuscripts, his first copy being always the last.

Besides editions of the *Eléments d'Euclide* of Père de Challes, of the *Géométrie Pratique*, and the *Traité du Sphère* of Boulanger, and some *Mémoires* in the Collection of the Academy, the *Journal des Savants*, and other publications, Ozanam wrote, 1. Tables des Sinus, Tangentes, et Secantes, et des Logarithmes, Lyon, 1670, and Paris, 1685, in 8vo; 2. Traité de Gnomonique, Paris, 1673, in 12mo; 3. La Géometrie Pratique, ibid. 1684, in 12mo; 4. Traité des Lignes de premier genre, de la construction des Equations, etc. ibid. 1687, in 8vo; 5. L'Usage du Compas de Proportion expliqué, ibid. 1688, in 8vo; 6. Dictionnaire Mathématique, ibid. 1690, in 4to; 7. Cours de Mathématiques, ibid. 1693, in five vols. 8vo, reprinted at Amsterdam in 1799; 8. Traité de la Fortification, containing the ancient and modern method for the construction and defence of strong places; 9. Récreations Mathématiques et Physiques, ibid. 1694, in two vols. 8vo; 10. Nouvelle Trigonométrie, 1699, in 12mo; 11. Méthode facile pour arpenter ou mésurer toutes sortes de Superficies, ibid. 1699, in 12mo; 12. Nouveaux Eléments d'Algèbre, Amsterdam, 1702, in 8vo; 13. La Perspective Théorique et Pratique, ibid. 1711, in 8vo; 14. La Géographie et Cosmographie, qui traite de la Sphère, ibid. 1711, in 8vo. Ozanam left in manuscript a treatise on the Analysis of Diophantus, which was in the library of D'Aguesseau. (See his *Eloge* by Fontenelle, the *Mémoires* of Niceron, and the Dictionary of Chaufepie.) (A.)

OZELL, John, a well-known translator, who received the rudiments of his education in the free school at Ashby de la Zouch, and completed his grammatical studies at Christ's Hospital, where he acquired a considerable knowledge of Latin, Greek, and Hebrew. It was the intention of his friends to send him to Cambridge; but, averse to the confinement of a college life, and perhaps disinclined to the clerical profession, he solicited and obtained employment in a public office of accounts, a situation for which he had been at much pains to qualify himself. His attention to business, however, did not divert his thoughts from literature. He made himself master of the principal modern languages, especially French, Italian, and Spanish; and from all these, as well as from the Latin and the Greek, he favoured the world with translations, which, if not remarkable for elegance, are generally pretty faithful to the originals. Ozell, though evidently a prudent man, had nevertheless a more exalted notion of his own abilities than the world was disposed to entertain; and this vain conceit probably led Pope to give him a place in the Dunciad, a species of distinction which seems to have annoyed him excessively. He died in the year 1743. (A.)

OZIERI, a city of the island of Sardinia, the capital of the diocese of the same name. It stands on a beautiful slope, in a healthy district, in which excellent wheat is raised and large flocks of sheep are pastured. Besides the cathedral, it contains several nunneries and monasteries, an hospital, and 7200 inhabitants.

OZERNAIA, a fortress of Asiatic Russia, in the government of Orenburg, on the Oural, and so named from the lakes by which it is surrounded. The village contains a church and 200 houses.

OZOLÆ, or Ozoli, a people who inhabited the eastern part of Ætolia, called *Ozolea.* This tract of territory lay at the northern extremity of the bay of Corinth, and extended about twelve miles. The name *Ozolæ*, on account of its indelicate signification, was highly disagreeable to the inhabitants; and they therefore exchanged it for that of Ætolians.

P.

P, THE fifteenth letter and eleventh consonant of the alphabet. The sound of it is formed by expressing the breath somewhat more suddenly than in forming the sound of *b;* but in other respects these two sounds are pretty much alike, and hence are often confounded. When *p* stands before *t* or *s*, its sound is lost; as in the words *psalms, psychology, Ptolemaic, ptisan*, and the like; but when placed before *h*, then both together have the sound *f*, as in *philosophy, physic*, and many other words. *P* and *B* are so like each other, that Quintilian declares, that in the word *obtinuit*, his reason required him to put a *b*, but that his ears could hear nothing but a *p*, *optinuit;* and hence, in ancient inscriptions and old glossaries, it appears that these two letters have often been confounded. Several nations still pronounce one for the other; the Welch and Germans particularly, who say, *ponum vinum*, for *bonum vinum.* Plutarch observes, that it was usual for those of Delphi to say βατειν for πατειν, βικρον for πικρον; and amongst the Latins, as often as an *s* followed, the *b* was changed into a *p*, as *scribo, scripsi.*

As an abbreviation, P stands for *Publius, Pondo*, &c. PA. DIG. for *Patricia Dignitas;* P. C. for *Patres Conscripti;* P. F. for *Publii Filius;* P. P. for *Propositum*, or *Propositum publicum;* P. R. for *Populus Romanus;* P. R. S. for *Prætoris sententia;* P. R. S. P. for *Præses provinciæ.* P. M. amongst *Astronomers*, is frequently used for *post meridiem*, or afternoon; and sometimes for *post mane*, after the morning, that is, after midnight. P was also used amongst the ancients as a numeral letter, signifying the same with the G, viz. a hundred, according to the verse of Ugutio,

> P similem cum G numerum monstratur habere;

though Baronius is rather inclined to think that it stood for seven. When a dash was placed on the top of $\overline{\mathrm{P}}$, it stood for four hundred thousand.

St Jerome, treating of Daniel, observes, that the Hebrews had no *P*, but that the *ph* served them instead of it; adding, that there is but one word in the whole Bible read with a *P*, viz. *apadno.* The Greek π signifies 80. On the French coins, *P* denotes those that were struck at Dijon.

In the Italian music, P stands for *piano*, or softly; and P. P. P. for *pianissimo*, or very softly. Amongst physicians, P stands for *pugil*, or the eighth part of an handful; P. Æ. *partes æquales*, or equal parts of the ingredients; P. P. signifies *pulvis panium*, or Jesuits' bark in powder; and *ppt. preparatus* or prepared.

PABULUM, amongst natural philosophers, is the same with FUEL.

PACAJES, a province of Bolivia, in South America, in the department of La Paz. It lies in the vicinity of the great lake of Titicaca, but its dimensions cannot be exactly stated. Being in the neighbourhood of the Andes, its climate is cold, and its soil not very productive. The inhabitants, who are distributed in about fifteen small settlements, consist chiefly of Indians, and are employed for the most part in tending cattle and sheep, with which the province abounds, being well adapted for grazing. Several mines of silver and emeralds were formerly worked here, but this pursuit is now abandoned. There is a mine of talc, however, which supplies the whole of Bolivia and Peru with plates of that substance, which is used as a substitute for window-glass. Pacajes, the capital of the province, is situated eighty miles south-west of La Paz, in a variable climate. Its chief commerce consists in the sale of cattle to the neighbouring towns.

PACCALONGAN, a small European town and fort on the northern coast of the island of Java. It is the seat of the resident, and is chiefly peopled by natives and Chinese, though there are a few Dutch families. It is situated on the great road across the island, and near a forest, which is remarkably unhealthy. It is 282 miles east from Batavia.

PACE, a measure taken from the space between the two feet of a man in walking, being usually reckoned two feet and a half, and in some men a yard or three feet. The geometrical pace is five feet; and 60,000 such paces make one degree on the equator.

PACE, in the manège, is of three kinds, viz, walk, trot, and gallop; to which may be added an amble, because some horses have it naturally. Horses which go shuffling, or with mixed paces between the walk and amble, are for the most part of no value. This commonly proceeds from their fiery temper, but sometimes from a weakness in their reins or legs.

PACEM, a town on the north coast of the island of Sumatra, the capital of a kingdom of the same name, dependent on Acheen. It contains above 500 families, and is 120 miles south-east of Acheen.

PACHAMAC, a valley of Peru, in South America, ten miles south of Lima. It is celebrated for its pleasantness and fertility, but still more on account of a magnificent temple built by the Incas of Peru, in honour of their gods. When the Spaniards conquered Peru they found immense riches in this temple.

PACIFIC OCEAN, the vast ocean which separates Asia from America. It is called *Pacific*, from the moderate weather which the first mariners who sailed in it experienced between the tropics; and it was called *South Sea*, because the Spaniards crossed the isthmus of Darien from north to south when they first discovered it, though it is properly the Western Ocean with regard to America.

PACKANGA, a town on the eastern coast of the Malay peninsula, situated on the river of the same name. It has now lost much of its former importance, though it is still conveniently situated for trade. Lat. 3. 32. N.

PACKET, or PACKET-BOAT, a vessel appointed to carry by sea, in the most expeditious manner, the mail of letter-packets, and expresses, from one kingdom to another.

PACTOLUS, in *Ancient Geography*, a river of Lydia, rising in Mount Tmolus, and also called *Chrysorhoas*, from its rolling down golden sand. From this river Crœsus is thought to have derived all his riches.

PACUVIUS, MARCUS, of Brundusium, in Calabria, a tragic poet of high reputation, who flourished about the year of Rome 600. He was nephew of Ennius; published several theatrical pieces, of which only some fragments remain; and died at Tarentum at above ninety years of age.

PADAH, a town of Hindustan, in the province of Gundwaneh, and district of Gangpoor, situated on the east side of the Soanke River, and belonging to an independent Hindu chief. Long. 84. 45. E. Lat. 22. N.

PADANG, a small island in the Eastern Seas, near the west coast of Borneo. Long. 109. 21. E. Lat. 0. 33. S.

PADANG-GUCHI, a small river of Sumatra, which runs into the sea on the western coast, between the 4th and 5th degrees of south latitude.

Padang, one of the principal Dutch settlements on the west coast of Sumatra, and to which all the other factories, as Pulo Chinco, Priaman, and Adjerhadja, were formerly subordinate. The town, with the fort, which is a square with four bastions of stone, is situated one mile up the river. There are on the opposite side mountains which command the fort at the distance of about 300 yards. Some pepper, camphor, and benzoin, are furnished; but since the establishment of the English at Bencoolen the quantity collected has been small. Padang was first visited by the English East India ships in 1649; it was then in possession of the Dutch, who retained it till 1781, when it was taken by the British, but given up at the peace of 1783. These settlements were again taken in 1794, but were given up to the Dutch at the general peace of 1814.

PADDINGTON, one of those parishes in the county of Middlesex which, by the increase of building in the vicinity of the metropolis, may be considered as a part of London, with which it is in contact on the north-east part. This in some measure accounts for its rapid growth, which has also been accelerated by the Grand Junction Canal terminating in a capacious basin furnished with storehouses for goods of all kinds. The parish-church is in the centre of a small green, and is an elegant object; and some new churches are in progress. In 1801, the population amounted to 1881, in 1811 to 4609, in 1821 to 6476, and in 1831 to 14,540.

PADDOC, or Paddoc-Course, a piece of ground encompassed with pales or a wall, and taken out of a park, for exhibiting races with greyhounds, for plates, wagers, and the like.

PADERBORN, a city of the Prussian province of Westphalia, in the government of Minden, and the capital of a circle of the same name, which extends over 108 square miles, and comprehends two cities, two towns, and thirty-eight villages, with 26,500 inhabitants. The city is built on the river Pader, and contains one Lutheran and four Catholic churches, two ancient monasteries now secularised, and one nunnery. It has 900 houses built in a very antique style, and a population of 6200 persons, chiefly Catholics. It was celebrated for a peculiar kind of linen, to which it gave its name. There are now some extensive breweries and distilleries. Long. 8. 38. 21. E. Lat. 52. 45. 32. N.

PADIHAM, a township and chapelry in the parish of Whalley, in the hundred of Blackburn, of the county of Lancaster, 213 miles from London. In 1801 the population amounted to 2118, in 1811 to 2556, in 1821 to 3060, and in 1831 to 3529.

PADSTOW, a seaport and market-town of Cornwall, in the hundred of Pydar, 243 miles from London, and thirty from Launceston. It is situated on the left bank of the river Alan or Camel, where there is a harbour which is rather difficult to enter, but secure within, and containing water for vessels of five hundred tons burden. It has a considerable pilchard fishery; and in summer it is resorted to for sea-bathing. The market is held on Saturday. In 1801 the population amounted to 1332, in 1811 to 1498, in 1821 to 1700, and in 1831 to 1822.

PADUA, a delegation of the Austrian province of Milan, in Italy, bounded on the north by Treviso, on the east by Venice, on the south by Polesina, and on the west by Verona and Vicenza. It extends over 837 square miles, is divided into twelve districts, containing 104 communes, and has a population of 296,000 persons. The land, except on the west side, is an extended plain. It is drained by the rivers Etsch, the Brenta, and the Musone; and it has numerous canals, which serve, many for irrigation, and some for navigation. The agriculture is well conducted, and yields abundantly wheat, maize, rice, and all kinds of horticultural products. Fruit is in superfluity, and much wine is made. Olives, hemp, flax, and silk are copiously grown, and afford employment to manufacturers, who fabricate various kinds of goods.

Padua, a city, the capital of the delegation of the same name, in Italy. It is built on the river Baglioni, which is connected by a canal with the several lagunes. It is surrounded with walls and ditches, and defended by several bastions. It has several fine squares, but the streets are narrow, and in general filthy, though they contain some very magnificent buildings, especially the palace or statehouse, the university, and the theatre. Besides the cathedral, it contains ninety-six churches and chapels, sixteen hospitals, and 6000 houses, with 46,300 inhabitants. Its university is an establishment of great celebrity, and has at present upwards of forty professors, though only about three hundred pupils. There are depending on it an observatory, an anatomical theatre, a library with 60,000 volumes, and similar institutions. It is a place of some trade in the manufacturing of woollen goods, which, however, are chiefly of the coarser kinds. There are also silk and linen manufactures, a trade in wine, oil, and leather, and a transit commerce by the canal. Long. 11. 46. 38. E. Lat. 45. 23. 40. N.

PADUAN, amongst medallists, a modern medal struck in imitation of the antique, or a new medal struck with all the marks and characters of antiquity. This name is properly applicable to those medals only which were struck in the seventh century by an Italian painter born at Padua, who succeeded so well in the imposture, that the best judges are at a loss to distinguish his medals from the genuine ones; but it is also used to signify all medals of this kind.

PADULA, a town of Naples, in the province of Principato Citeriore. It stands in the Valley of Diana, between hills, and contains 5900 inhabitants.

PADUS, now the Po, anciently called *Eridanus*, especially by the Greeks, a river of Italy, celebrated in fable.

PÆAN, amongst the ancient pagans, was a song of rejoicing sung in honour of Apollo, and chiefly used on occasions of victory and triumph.

Pæan, in the ancient poetry, is a foot consisting of four syllables, of which there are four kinds; the pæan primus, secundus, tertius, and quartus. The pæan primus consists of one long syllable and three short ones, or a trochæus and pyrrhichius, as *temporibus*; the pæan secundus consists of a short syllable, a long, and two short, or an iambus and a pyrrhichius, as *potentia*; the pæan tertius consists of two short syllables, with a long and a short one, or a pyrrhichius and a trochæus, as *animatus*; and the pæan quartus consists of three short syllables and a long one, or a pyrrhichius and iambus, as *celeritas*.

PÆDO-BAPTISM, infant baptism, or that conferred on children: from παις, *infant*, and βαπτισμα, *baptism*. This has been the subject of great controversy in the church.

PAGAHM, an eminent city of the Burman empire, situated on the eastern bank of the Irrawuddy. This city was formerly the residence of a dynasty of kings, and it still contains numerous temples, in a superior style of architecture to those built in later times. Little remains of the city except a brick rampart. It has, however, a good market, well supplied with grain, oil, fish, and vegetables. Long. 94. 35. E. Lat. 21. 9. N.

PAGAN, Blaise Francois Comte de, an eminent French mathematician, was born at Avignon, in Provence, on the 3d of March 1604, and embraced the profession of arms at fourteen, having been bred to it with the greatest care. In 1620 he was engaged at the siege of Caen, in the battle of Pont de Cé, and the reduction of the Navarrese, and the rest of Béarn, where he signalized himself, and acquired a reputation far surpassing his years. He was present in 1621 at the siege of St John d'Angeli; as also at that of Clarac and Montauban, where he lost his left eye by a musket-shot. After this time there happened neither siege nor battle in which he did not signalize himself by some effort of courage and conduct. At the passage of the Alps and the barricade of Suza, he put himself at the head of the forlorn hope, and immediately began a furious assault, and, the army coming to his assistance, forced the barricades. When the king laid siege to Nancy in 1633, Count Pagan had the honour to attend his sovereign, in drawing the lines and forts of circumvallation. In 1642 his majesty sent him to serve in Portugal in the capacity of field-marshal; and in the same year he unfortunately lost his eye-sight. But though he was thus disabled from serving his country in the field, he resumed, with greater vigour than ever, the study of the mathematics and fortification, and, in 1645, gave the public a treatise on this latter subject. In 1651 he published his Geometrical Theorems, which show a perfect knowledge of all parts of the mathematics. In 1657 he published his Theory of the Planets, a work which distinguished him amongst astronomers as much as that on fortification did amongst engineers; and, in 1658, his Astronomical Tables. Count Pagan died at Paris on the 18th of November 1665.

PAGANALIA, certain festivals observed by the ancient Romans in the month of January. They were instituted by Servius Tullius, who appointed a certain number of villages (*pagi*), in each of which an altar was to be raised for annual sacrifices to their tutelar gods; at these all the inhabitants were to assist, and give presents in money, according to their sex and age, by which means the number of country people was known. The servants upon this occasion offered cakes to Ceres and Tellus, in order to obtain plentiful harvests.

PAGANISM, the worship or adoration of false gods.

PAGEANT, a triumphal car, chariot, arch, or other similar decoration, variously adorned with colours, flags, &c. carried about in public shows and processions.

PAGES, three small rocky islets in the strait between Kangaroo Island and the main shore of New Holland. Long. 138. 21. E. Lat. 35. 46. S.

PAGI, ANTONY, one of the ablest critics of his time, was born at Rogne in Provence in the year 1624. He devoted himself to the study of chronology and ecclesiastical history, in which he excelled. His principal work is, a criticism on the Annals of Baronius, in which he has rectified a great number of mistakes both in chronology and in facts. Pagi died in 1699.

PAGNANI, a large market-town of Italy, in the province Principato Citeriore, of the kingdom of Naples. It now contains, with adjoining villages, 9630 inhabitants.

PAGNINUS, SANCTES, an Italian Dominican, eminent for his skill in oriental languages and biblical learning, was born at Lucca in 1466. He was deeply and accurately skilled in Latin, Greek, Hebrew, Chaldaic, and Arabic, but particularly in the Hebrew. He applied himself to examine the vulgar translation of the Scriptures; and believing it to be greatly corrupted, he undertook to make a new one from the Hebrew text. The design of Pagninus seemed a bold one; yet such was his reputation, that it was approved by Leo X., who promised to furnish him with all necessary means for carrying on the work, which was printed at Lyons in 1527. This is the first modern translation of the Bible from the Hebrew text. Pagninus, however, is thought to have adhered with too great servility to the original text, and thus to have rendered his translation obscure, barbarous, and full of solecisms. He also translated the New Testament from the Greek; and was author of a Hebrew Lexicon and a Hebrew Grammar. He died in 1536, aged seventy. Luther spoke of him and his translations in terms of the highest praise.

PAGO, an island in the Adriatic, forming a portion of the Austrian province of Dalmatia. It is long, and of a singular form, with several peninsulas, and abounds in salt lagunes, from which much culinary salt is made. The island abounds in excellent coal. It contains 4300 inhabitants of the Sclavonian race.

PAGOD, or PAGODA, a name given by the Hindus and others to the temples where they worship their gods.

PAGOD, or *Pagoda*, is also the name of a gold and silver coin, current in several parts of the East Indies.

PAHANG, or PULO PAHANG, a small island in the Eastern Seas, near the coast of Malacca, five miles east from the town of Pahang.

PAHANG, a town of Malacca, on the east coast, situated twelve miles from the sea, on a broad and shallow river, full of shoals. It is divided at its mouth, which is situated in lat. 3. 45. N., into two channels, which are navigable for small vessels up to the town. It is enclosed by a wall made of the trunks of trees joined close together, and about twenty-four feet in height. The streets are fenced on both sides with hedges of reeds, and planted with cocoa and other trees; so that it has more the appearance of an assemblage of gardens than of a regular city. It formerly carried on a considerable trade, and was visited by vessels from various parts of India, such as Bantam, Batavia, Japan, and China. At present the trade is carried on in vessels belonging to the place, in which are imported articles of European manufacture, such as iron, cutlery, glass; also piece-goods, woollens, tobacco, &c. In return they receive from the eastern islands cloves, elephants' teeth, mace, nutmegs, rattans, sago, tortoise-shell. Gold-dust, with which the river abounds, is also a principal article of trade. The mouth of the river is in lat. 3. 45. N.

PAHO, a river on the west coast of the isle of Celebes, which runs into the Straits of Macassar. Long. 119. 52. E. Lat. 3. 10. S.

PAIMBŒUF, an arrondissement of the department of the Lower Loire, in France, 332 square miles in extent. It comprehends five cantons, divided into twenty-six communes, and contains 39,800 inhabitants. The capital is the city of the same name, situated on the left bank of the Loire, and nine miles from its mouth. It has a good haven, where the larger ships discharge their lading into craft to convey it to Nantes. There are several establishments for building and repairing ships. The city contains 800 houses and 3980 inhabitants.

PAINOMJEUNG, a castle of Thibet, situated on a perpendicular rock washed by a river which flows at its foot. Long. 89. 10. E. Lat. 29. N.

PAINSWICK, a market-town of the county of Gloucester, in the hundred of Bisley, 101 miles from London, and seven from Gloucester. It is pleasantly situated on the banks of a small stream which empties itself into the Stroud. The town is not large; but the parish is divided into four lythings, and contains 6510 acres of land. It is a place of great antiquity, having a church of various styles of architecture, with a tower, on which is a spire rising to the height of 174 feet. On the summit of a hill called Spire Head, adjoining to the town, are the ruins of an ancient fortification called Kingsbury Castle. It has a good market, which is held on Tuesday. The principal occupation consists in making superfine woollen cloths; and, by the population returns of 1831, the number of the families employed in trade and manufactures was 448, whilst those employed in agriculture were 195, and all others 243. In 1801 the population amounted to 3150, in 1811 to 3201, in 1821 to 4044, and in 1831 to 4099.

PAINTING.

Painting. Definition.

Painting is the art of conveying thought by the imitation of things through the medium of form and colour, light and shadow. Colour, and light and shadow, can by themselves do little more than excite sensations of harmony and sentiment, independently of action, passion, or story; but if founded upon form, thoughts become clear, expressions of passion intelligible, and actions, gestures, and motions of the human frame defined and decided. *Form* therefore is the basis of painting, sculpture, architecture, and design of every description.

Any school of painting, therefore, which is established upon a principle different from this, or which makes the subordinate parts of colour, light, and shadow the principal law of its practice instead of a component part, is in opposition to the most celebrated schools in the world; for the most eminent both in Greece and in Italy, were indebted for their celebrity and renown to the strict observance of the doctrine here enunciated. In Greece, the schools of Sicyon, Corinth, Athens and Rhodes, and in Italy, those of Pisa, Florence, Rome, and Bologna, were the most important, the most useful, and the most intellectual; and in all these *form* constituted the great and fundamental law of their practice. But in Venice, colour took the lead; it predominated too in Holland and Flanders; and it has always reigned, to the sacrifice of common sense, in Britain. Yet for sound and philosophical views of art, as a vehicle of passion or of moral national influence, neither of these schools can be referred to, with the same conviction or confidence with which all nations can refer to the former great sources of sense, principle, and genius.

Origin of Painting.

In what country Painting first originated, is nearly as difficult to discover, as it is to find a country where it never existed at all. Design, the basis of painting, must have begun with the very first instrument of necessity which man required. The origin of any art, science, or discovery, is not so much owing to the particular accident which happened to the individual concerned, as to the intellectual adaptation of that individual to receive impressions of a peculiar nature from the particular circumstance which occurred. Thus whether Music was invented by the man, who, listening to the sound of an anvil, instantly composed notes; or whether Painting was discovered by the lovely girl, who, watching the shadow of her lover, as he sat silent at the prospect of parting, traced it upon the wall as a memento of their mutual affection; whether it originated with Philocles in Egypt, or Cleanthes in Corinth, or long before Egypt or Greece were habitable; the *principle* is the same. Without an inherent susceptibility to the impressions of sound, in preference to all other impressions, in the man, or an inherent susceptibility to the impressions of form equally intense in the girl, the intellectual faculties of either would have never been excited to compose notes, or to define figures. The art originated with the first man who was born with such acute sensibility to the beauty of form, colour, and light and shadow, as to be impelled to convey his thoughts by positive imitation.

When the Spaniards landed in South America, the mode by which the natives conveyed intelligence of their arrival to king Montezuma was by painting the clothes of the strangers, their looks, their dress, and their ships. This certainly must have been the most ancient, because the most simple and obvious mode in the world of conveying thought, after oral communication. But independently of all theory, there cannot be a doubt of the extreme antiquity of painting. The walls of Babylon were painted after nature with different species of animals, hunting expeditions, and combats. Simiramis was represented on horseback striking a leopard with a dart, and her husband Ninus wounding a lion. "And I went in and saw, and behold every form of creeping things, and abominable beasts, and all the idols of the house of Israel, *pourtrayed on the wall round about.*" (Ezek. viii. 18.) "She saw men *pourtrayed upon the wall,* the images of the Chaldeans *pourtrayed in vermilion,* girded with girdles upon their loins, exceeding in *dyed attire* upon their heads, all of them princes to look at, after the manner of the *Babylonians and Chaldeans.*" (chap. xxiii. 14, 15.) It is inferred from a passage of Diodorus Siculus, that these figures were painted first on the brick before burning, and then vitrified by fire.[1] But before this was done, experience must have been acquired of the liability to decay of painting upon external walls; and considering, too, that great statues were erected in Babylon, the arts must have existed amongst the Babylonians long before the period here referred to.

Antiquity of art in Ethiopia.

But a great revolution has taken place in our ideas on this subject, from the decyphering of hieroglyphics, and we are now assured of the extreme antiquity of art, in ages hitherto deemed almost entirely fabulous. From Asiatic art we have been accustomed to turn to that of the Egyptians; but it is no longer considered as a matter of speculation that the Ethiopians preceded the latter in knowledge, and that from this ancient people the Egyptians received gradually a knowledge of art. The course of civilisation probably descended from Ethiopia to Egypt; and yet we have evidence of the existence of Egyptian painting and sculpture more than eighteen centuries before Christ, and even then the arts were in the highest condition that the Egyptian school ever attained. From the most ancient records of the Jewish and Greek historians, in which Egyptian and Ethiopian monarchs are mentioned, and their actions narrated, we can now turn to corresponding traces of their existence and exploits commemorated upon the durable materials of the temples, tombs, and palaces which still remain. When therefore it is found that this method of interpreting hieroglyphics has proved to be correct, in all that we know of the Cæsars and the Ptolemies, or see casually alluded to respecting the Pharaohs, we have no right at all to dispute the truth of the same mode of interpretation when it indicates a still higher antiquity, though we have not the means of confirming it by collateral reference. Eighty miles above Dongola, Lord Prudhoe discovered the remains of a magnificent city, which he conceives to have been the capital of Tirhakah mentioned in the Bible; and amongst these ruins he observed two nobly executed lions, specimens of Ethiopian skill. On the shoulders of one is the name of Amenoph III., who was called Memnon by Greek historians. The style and execution of these great works are evidence of the talent of this people.[2] It is now certain that as early as the nineteenth century before Christ, the walls and temples of Thebes were decorated with paintings and sculpture, commemorating personal and historical events; and certainly in comparing the designs on these temples with those of a later period, we must conclude that the Egyptian school of painting never exceeded their merit.[3]

The conclusion to be drawn is, that at this time the Egyp-

[1] Barry's *Lectures.*

[2] Now in the Bristol Museum.

[3] See last vol. of Sculpture, (*Dilletanti.*)

Painting. tian priesthood had not interfered with art or artists; but that the painters were left freely to commemorate the great actions of their employers, to study nature, and to do as they liked. Many of these actions are delineated in a natural manner, and there is a great deal of dignity in the figure of the hero; the sea fights are also well grouped, and there are many of the Trajan-column figures, and not more gross perspective is visible. The colour is a mere illumination, and the composition as a whole infantine; but there is proportion, and not absolute ignorance of the component parts.[1] After this period, art became a mere tool in the hands of the priests; and as the law compelled the son to follow the profession of his father, it may be supposed that painting degenerated into the mere fac-simile of prescribed forms of gods, godesses, and men, and that in the time of the Ptolemies it was little better than an illuminated hieroglyphic.

Character of Egyptian design.

The Egyptians appear to have done every thing with reference to form. Their painting was at best but coloured sculpture. They seem to have been aware of the mortality of colours, and to have said, "As colours must go, let us cut out the designs in stone, so that at least form may remain in our granite sculpture, and defy every thing but the convulsion of the earth." First the designer drew the outline in red, then the master artist corrected it, then the sculptor cut it, then the painter coloured it, gods blue, goddesses yellow, men red, and draperies green and black; and such is the extreme dryness of the climate, that a traveller says, he saw in Nubia, a bas-relief half cut, with the red outline left for the rest, and that he wetted his finger and put it up, and immediately obliterated a part of the red chalk.

The Egyptians would seem to have been a severe people, as hard as their own granite.[2] They had an awful feeling of respect for the wisdom of their ancestors; they hated reform; no physician dared to prescribe a new medicine, and no painter dared to invent a new thought. Plato says, that the pictures of his day in Egypt were just the same as from ages immemorial;[3] and, according to Winkelman, another cause of their inferiority in painting, was the little estimation in which painters were held, and their extreme ignorance. Not a single painter of eminence has reached us, and but one sculptor, viz. Memnon, author of three statues at the entrance of the great temple at Thebes. In the knowledge of the figure it is impossible they could be great; for there is proof that they dared not touch the dead body for dissection, and even the embalmers risked their lives from the hatred of the populace.

Winkelman divides Egyptian design into three periods: First, from the earliest times to the conquest of Cambyses; secondly, from the conquest of Cambyses to the subjugation of the Persian and the establishment of the Greek dynasty in Egypt; and, thirdly, from that period to the time of Hadrian.[4] When the paintings at Thebes were executed is not known. But they were upon the walls at the expulsion of the Shepherd Kings,[5] and this was the first period of their art, and before Moses. The Egyptians never, in either art, reached the power of making men, as Aristotle said of Polygnotus, *better* than they were; in other words, they never attained the true ideal beauty, founded on nature, yet above it. Their figures are debased transcripts of what they had about them, and therefore, so far authentic as to character. The Egyptian female heads are far from displeasing; they have a sleepy voluptuous eye,[6] a full and pleasant mouth, high cheek bones, dark brows, and there is something by no means disagreeable in the silent lazy look of their expression. But the very want of ideal beauty gives an assurance that the figures are Egyptian nature, and that every habit, public, private, civil and religious, is laid open to us, by the wonderful discoveries of Belzoni and his followers: it is almost as impossible now for an artist to be incorrect in painting an Egyptian subject, as it would be to err in painting a British one. In a tomb laid open by Belzoni, the characters of the procession were admirably distinguished; the Jew, the Egyptian, the Negro, and the Chaldæan, were as little liable to be confounded as if they had been before us. In their sculpture, however, there is more of science than in their painting. Sculpture was practised by the priesthood, and sculptors were called sacred stone-cutters. The great head of Memnon in the British Museum, is beautifully cut, the nose and mouth especially; and, considering its remote antiquity, it is really a great wonder.

Upon the whole, it is impossible to believe that the art of painting, amongst other nations, owed much to the Egyptians; they had no colour, and no light and shadow, but only some form, some expression, and some character. The groups of the ruins of Elythia shew a great deal of nature and simplicity; the animals are varied, and the cows are lowing and gamboling; yet it is after all but childish work, and as the paintings at Thebes are the best, those of Elythia have not much to boast of.

Whether the Greeks owe their beginnings to Egypt, is more than doubtful, from the simple fact of the early Greek painters using *no blue*, whilst it was the constant practice of Egyptian painters to use blue in every thing.[7] Athens was founded by an Egyptian colony, and painters might be amongst the emigrants, as well as masons and sculptors; yet in the early state of things, painters were not an article of necessity, and it is problematical if in this alleged emigration, there were any persons of that class. The beginning of art was the same in all nations. They might improve each other; but we do not believe that painting was ever originally brought into one nation by another, or that there ever existed any, where it has not always been more or less known from the remotest period of their history.

State of art amongst the Hebrews and other Eastern nations.

After Ethiopian, and Egyptian art, that of the Hebrew people must next be examined. That they had sculptors and chasers, is evident; but it is not so certain that painting was practised. Though the cunning work of the curtains in Exodus means tapestry, and for any cunning work of the kind, designs coloured must have been executed; yet there is no proof in any part of the Bible that painting as an art was ever practised by them; and even the designs alluded to, were exclusively applied for the purposes of religion. "Moreover, thou shalt make the tabernacle with ten curtains of fine twined linen, with blue, and purple, and scarlet; with cherubim of cunning work shalt thou make them." (Exodus xxvi. 1.) "And the Lord spake unto Moses, saying, See, I have called by name Bezaleel the son of Uri, the son of Hur, of the tribe of Judah; and I have filled him with the spirit of God, in wisdom, and in understanding, and in knowledge, and in all manner of workmanship, to devise cunning works, to work in gold, and in silver, and in brass, and in cutting of stones, to set them, and in carving of timber, to work in all *manner of workmanship.*" (Exod. xxxi. 1—5.) Yet when Solomon wanted artists, he sent to Tyre, which is presumptive evidence of a deficiency of skill at Jerusalem. No allusion is made to the existence of the art of painting amongst the Hebrews; yet it is hardly possible to suppose a people working in stone, and silver, and gold, and timber, designing and weaving a cunning work of cherubims on curtains and bor-

[1] See the French national work on Egypt.
[2] *Odyss.* lib. xvii. v. 448.
[3] *De Legibus*, lib. 2.
[4] Wink. lib. ii. chap. 2.
[5] See 2d vol. of *Ancient Sculpture*, (Dilletanti.)
[6] See *Description de l'Egypte*, tom. i. plates.
[7] Col. Leake says there is a remnant of blue on the temple of Theseus; but that may be as applied to architecture. The question is, whether the great painters used it in their art. Pliny says no, and Quintilian confirms him by applying to them the expression *simplex color.* No colour is *simplex* where pure blue is used.

ders for garments, and having been so long amongst the Egyptians, to have been ignorant of painting; but it is the opinion of one of the greatest living authorities in the church, that the representation of any object by painting was not permitted to the Hebrews.

With respect to the painting of the Phœnicians, Persians, Indians, and Chinese, it was in the earliest ages, and has ever since been, miserable and wretched. Although the Indians and Persians have always been celebrated for their tapestry, yet it is more for the excellence of the material than the purity of their designs. You may know a tiger from an elephant, though scarcely from a monkey, in their tapestry, shawls, and carpets; but in their utter ignorance of the naked figure, their long, barbarous, and cumbersome garments, and their want of science, are so grossly palpable, that they have never been, and never will be, referred to by any nation as authority in design. In their coins, however, the ancient Phœnicians shewed more knowledge of the form than the Persians, the Chinese, or the Indians.

Etruscan

From the painting of these Eastern nations, we may now justifiably approach a people, whose origin, history, and science, have puzzled historians more than perhaps the Atlantides themselves. Who the Etruscans were nobody knows; but all agree that they were not aborigines, and this is establishing something. Yet it can scarcely be questioned that in their most remote, as well as their more refined periods, they were indebted for their arts, their language, and their religion, principally to the Grecians. The time when the Etruscans had commercial relations with Egypt and Greece, is hardly known;[1] but as their early style of art is a little Egyptian and their subjects Grecian, they were no doubt connected with both, even before the Greeks had settled in Italy. It is not yet decided where they came from, and who they were, and if one consults all who have written on the subject from Herodotus to M. Raoul-Rochette, he is likely to be as open to a new theory as when he began. Their early works prove nothing. These are like the early works of almost all barbarous nations. The gods of the Etruscans are, in point of art, the gods of the Peruvians, the Sandwich Islanders, or the Esquimaux. Idols are idols, in early nations all over the world; and the bandy-legged Apollos, squinting Pans, and *Dii indigenetes*, sixteen heads high, of this mysterious people, would do as well for any of the gods of the South Seas, as the early barbarians of the Mediterranean.[2] When commerce brought them in contact with Greece and Egypt, traces of the art of both nations become apparent; but this is no evidence that they came exclusively from one nation or from the other.

Winkelman is a person of great genius, and always touches art as if he saw the whole ground. He divides Etruscan art into three epochs, Heyne into five;[3] he goes to leading points, Heyne enters into details. The first epoch was gross; the second exhibited traces of Greek or Pelasgic art; the third had a taint of Ægyptian; the fourth was better; the fifth produced ideal beauty and Greek mythology; and this completes the period till decay. Campania was colonized 801 B.C.; but the Eubæans had founded Cuma 1550 B.C. This neighbourhood brought the Etruscans in contact with Greek art, when about the ninth or eleventh Olympiad Greek colonies were established in Sicily; and the intercourse being reciprocal and complete, it cannot be wondered, that the more ignorant of the two nations became fascinated and inoculated by the superior one, and thus rendered Etruscan so like Greek art, that it has ever since produced doubt and confusion.

According to Pliny, the arrival of Demaratus with Cleanthes from Corinth, first brought art into Etruria about 650 B.C.; yet, he says, there were beautiful pictures at Ardea and Lanuvium, which were older than Rome, and Rome was founded 754 B.C. Heyne says, that before Rome was built, casting of metal, sculpture, and painting existed in Etruria anterior to any connection of the Etruscans with Greece; according to Winkelman the Etruscans were advanced in art before the Greeks, and it was a tradition of the remote ages, that Dædalus flying from Minos settled in Etruria and first sowed the seeds of design. When Etruria became a Roman province, Marcus Flavius Flaccus besieged Volsinium, the etymological meaning of which is, "The town of artists," and brought away two thousand statues from that city alone. An able writer, in the "Newcastle Transactions" contends, that it is doubtful if the Etruscans had any art before the arrival of the Greeks.[4] No historian of this nation has reached us; their inscriptions are not yet thoroughly decyphered; and as the Romans destroyed every monument of surrounding nations, there is no fixing their antiquity. It is clear, however, that painting flourished in Italy before it did in Greece; such at least is the opinion of Tiraboschi.[5] Pliny says nothing about it before the 18th Olympiad in Greece, whereas in the 16th there were paintings in the above towns in Italy, and works too shewing great refinement; which the Romans admired in their days of splendour, and which their emperors wished to remove, surrounded as they were by the finest productions of Grecian art. Their civil and religious rites not being the same as the Egyptians, and there being no traces of embalming, it may thence be concluded that they were not of Egyptian origin.

All hopes of discovering any of their paintings, any important work which should give us evidence of their talents in art, were given up, till in 1760 Pacciaudi discovered at Tarquinia, tombs decorated with designs; and in 1837 fac-similes of pictural decorations of other tombs were exhibited in London, with the monumental statues themselves, and in parts were extremely beautiful in taste, design, expression, and drapery. The extremities were correctly and sweetly drawn; and the expression and character of the head, which were very interesting, would not have disgraced any period of Greek or Italian design, though they would not have honoured the finest. It is impossible to judge of the colour of the Etruscan school from these specimens, or from the vases called Etruscan. Fresco, stucco, or distemper are adapted neither for depth nor for tone; oil or encaustic is the only vehicle fit for harmony, and oil or encaustic was never practised by them. With respect to the painted vases called Etruscan, because they are found in Etruria, we might just as well assert, if one discovered in the middle of Yorkshire, a mass of china, that it must be of English manufacture because it was found in Yorkshire. After the Greeks had settled in the south, their vases might be and no doubt were an article of commerce; of course they were imitated, but surely the design and origin are wholly Grecian, whatever the Etruscans might after long intercourse do in the way of imitation. The principles of design and proportion in these beautiful productions, are the same as in the finest works of Greek sculpture, with an occasional but trifling variation. Raffaelle himself could not have exceeded the purity of form expressed by line, in drapery or figure. In the finest vases the artists seem to have been perfect masters of the figure, and to have gone right round with the stylus, till the contour of the part was completely expressed. Nor is there any thing wonderful in this, considering the manner in which Greek artists and manufacturers began, proceeded, and concluded their studies. According to Plato, a perfect mastery of the forms

[1] B.C. 1556.
[2] See Gorius.
[3] See Heyne's Notes on Winkelman, vol. i.
[4] This is a most able article, and the reader is referred to it for more extensive information on the Etruscans.
[5] *Storia della Letteratura Italiana.*

of man and animal was the basis of all instruction in design.

We have thus brought down the history of the art to a period, when our information, though imperfect, is more certain; but we can never sufficiently estimate the loss of all the ancient treatises on art, though we ought to be very grateful for what we possess in Plato and Aristotle, Pliny and Quintilian, and other ancient writers, Greek and Roman, down to the middle ages, and till the subject was taken up by Vasari and Lanzi. The continued existence of this glorious art, can always be proved, more or less subject of course, like every thing human, to those alternations of splendour and calamity, triumph and misfortune, which are the lot of every thing here below.

Greek school of art.

The superiority of the Greeks in art is always attributed to the secondary causes of climate and government, forgetting the one important requisite, without which the influence of the most genial climate, or the patronage of the most perfect government could avail little; we mean natural and inherent genius. If the Athenians, the Rhodians, the Corinthians, and the Sicyonians owed their excellence in art to the climate, why did not the same climate produce equal perfection in the Spartans and Arcadians? If climate be the secret, why are not all people under the same latitude equally gifted and equally refined? Climate may be more or less favourable to intellectual development, but is never the cause of its existence. Government may elicit genius by fostering and reward, but can never create it. All the lamentation about the climate of England, Scotland, or Flanders, did not prevent Hogarth's appearance in the first, Wilkie's in the second, or Rubens' in the last of these countries; nor could all the beauty of climate in Greece or Italy, ever have made Mengs a Raffaelle, or David the Titian of modern times. It would be absurd to deny altogether the influence of climate in the extremes. It is not impossible but that genius might melt to indolence under the line, or freeze to apathy within the arctic circle; but even genius there would assert its superiority in something or in some way. What we contend for is, that Winkelman's theory of limiting the gifts of God, intellectual or corporeal, to latitude or longitude, is not borne out by facts, the great test of all theoretical principles.

The Greeks were idolaters, and their love of beauty was a principle of their religion. The more beautiful a face or form could be rendered in painting or sculpture, the better chance had the artist of the blessing of the gods here, and their immortal rewards hereafter. As beauty was so much prized by this highly-endowed people, those who were gifted with it became ambitious of making it known to great artists, and by them to the world. Artists fixed the fame of beauty in man or woman, and even children who gave promise of being beautiful were allowed to contest for a prize, and the child who won it had a statue erected to him. Many people were complimented by being named from the beauty of any particular part, and Winkelman quotes an instance, where one was called Χαριτοβλεφαρος that is, "having eyelids where the graces sat." There were games instituted near the river Alphæus, where prizes were adjudged to the most beautiful; and the Lacedæmonian women in their bed-rooms kept continually before their eyes the finest statues. Still, this admiration of beauty was but a secondary cause; for though the Lacedæmonians showed this love of beauty, they did not produce great artists. The Greeks had a strong sensibility to beauty and an intense acuteness of understanding. Every artist was a philosopher, and every philosopher relished art, and understood it. The artists began by the study of geometry and of form; they analyzed the peculiarities of the form of man, by contrasting it with that of the brutes, and they settled the principles of beauty in that form and figure. The philosophers recommended to all classes the study of art, as a refined mode of elevating their perception of beauty; and the government seconded the recommendation of the philosophers. The priests found the religious feeling rendered more acute by painting and sculpture; and the authorities discovered, that the emotions of patriotism were doubled by the commemoration of great national events, in temples and in public halls. Now, add climate as adapted for such productions and their preservation, and genius, the gift of God, as the first cause, and no one surely need wonder that all these causes mutually acting on each other produced the miracles of perfection in art, which the world has gazed at ever since with an incredulous and bewildered astonishment.

The passion for the beautiful in poetry, painting, music, and nature, led them to abhor the bloody amusements of the Romans. To contest for glory by pictures, poems, or music, to race for the prize of swiftness, or wrestle for the crown of strength, were the innocent and delightful objects of their Olympic games; and during those noble commemorations, war ceased, and all Greece assembled in happiness and joy. Even the harsh Spartans signed a truce of fifty days with the Messenians, that they might keep a fête in honour of Hyacinthus. The greatest men disdained not these contests. Plato appeared amongst the wrestlers at Corinth, and Pythagoras carried off the prize at Elis. What must have been the effect of all this upon a people of strong susceptibilities and of high natural genius?

Consider the respect which must have been paid to great artists, when such a man as Socrates pronounced them the only wise men. Æsop took the greatest pleasure in lounging in their painting-rooms; Marcus Aurelius took lessons in philosophy from an artist, and always said that the latter first taught him to distinguish the true from the false; and when Paulus Æmilius sent to the Athenians for one of their ablest philosophers to educate his children, they selected Metrodorus the painter, and, let it be remembered, that amongst the children placed under *his* care, was one of the Scipios. What must have been the effect on the rising youth of Greece when the Amphictyonic council decreed that Polygnotus, their greatest monumental painter, should be maintained at the public expense wherever he went, as a mark of the national admiration for his greatest work, the Hall at Delphi. The glory and the fortune of a great painter did not depend, as now, upon the caprice of individuals; he was the property of the nation; he was employed by countries and by cities; and his rewards were considered as a just portion of the national expenditure. The educated and the high-born were brought up with a conviction of the propriety and justice of this principle; and when they became members of the government, considered this as useful a method of public expenditure, as squandering thousands on matters merely diplomatic, or in vain shows, mummings, and pageants. And such will yet be the system of our own country, when the people become fully instructed, and are made sensible of the moral and commercial influence of painting.

When we reflect upon the money spent in England by the government, and the consequences which so often attend that expenditure, and when we find in Greece the different results of the same interference on the part of the state, and that the works there produced have been canons of beauty to the world ever since; it is natural to inquire, what was the system by means of which genius was so successfully rewarded? The secondary causes must have been, the competence of the tribunals to which poets, painters, musicians, sculptors, historians, wrestlers, boxers, and philosophers with such confidence appealed. It must have been the taste and

[1] See a beautiful passage *De Legibus*, lib. ii. p. 669.—If every scholar would mark and transcribe every passage relating to art, a code might soon be made out.

Painting. knowledge of the members which composed the judgment-boards, and their sincere conviction of the importance of their office. One has only to sift for a moment the nature of their greatest tribunal, that of the Olympic games; one has only to reflect on the deep feeling, the solemn sincerity, the awful piety of their conviction, that what they had to do involved the future prospects of the rising youth of Greece, and that on their moral honesty depended the glory of their country, and that of its painters, sculptors, architects, philosophers, poets, and heroes. Before proceeding to detail the rise and progress of Greek art, and Greek artists, as the painting of every nation is connected with its civil, religious, and scientific institutions, (though more must always depend on highly-gifted individual effort to advance the knowledge of mankind, than any given assemblage of inferior individuals;) a rapid examination of the principles which guided the decision of one of their most important tribunals, composed of the greatest men the world has seen, ought to form a portion of every history of the art.

Olympic tribunal. Aristotle in his *Politics*,[1] as quoted by Mr. Hamilton in his pamphlet on the Houses of Parliament, observes: "All were taught γραμματα or literature, gymnastics, and music, and many την γραφικην, or the *art of design*, as being abundantly useful for the purposes of life, but mainly because it enables us to appreciate the merits of distinguished artists, and carries us to the contemplation of *real beauty*; as letters, which are the elements of calculation, terminate in the contemplation of truth." A people thus educated, to understand the basis of beauty in art, and to believe that their decisions, when they became judges of genius, involved their own intellectual taste and repute, and who gave their decisions in the presence of kings, philosophers, and people, were as little likely to be biassed by unjust predeliction as human nature could be; though, of course, in the corrupt times of Nero and the emperors, great abuses took place. But in the Marathonian period, if ever partiality was banished from human honours, it was banished from the Olympic games, in those immortal days of glory and patriotism. At this extraordinary assemblage, kings entered the lists, and nations respected the judgment, or if they refused to abide by the decision of a just tribunal, they were excluded by vote till they paid the fine and acknowledged their error. And what was the result? The highest honours were obtained in these contests, because every one gifted in art, poetry, music, or physical strength, knew that if he deserved the olive-crown, no partiality, no nephew of the judge's sister, or first cousin of the judge's wife, would deprive him of his due. Every being did his best, and if that *best* failed, he had a consoling conscious conviction that he had been honourably, and honestly, and nobly beaten by a better. It is astonishing, if once entire confidence exist between judge and competitor, to what a degree this confidence affects both; what a spring it gives to mind and body, and how honestly every thing is done: And if confidence be, from repeated experience, withheld, it is wonderful how half the faculties of the mind, and the powers of the body and soul, sink under the impression. Napoleon used to say, "that if the moral feeling of an army was in favour of a campaign, it was equal to 40,000 men." If moral confidence be lost in such cases, disgust is generated, and apathy, indifference, and failure are the result.

In order to understand the Greek character thoroughly, the system of excitement that was worked on, and the materials that were used to rouse the energies of competitors, it will conduce to the understanding of the secondary causes of their perfection, if the nature of the Olympic games be examined.[2] They are universally acknowledged to have subsisted before the rise of chronological dates and records; and the record of the Olympic conquerors after their restoration, is the first known chronological date. Pausanias says they were celebrated every five years, that is, they were celebrated on the fifth year after the fourth had passed; and Sir Isaac Newton is of opinion that they were originally instituted in celebration of victories. Why the Olympic games had always the preference, there is no knowing; but the grand statue of Jupiter at Elis, must no doubt have had considerable influence.

The privilege of presiding at the Olympic games was attended with such dignity and power, that the Eleans who had been in possession of it from the earliest times, were more than once obliged to maintain their right by force of arms. After various disputes about the number of presidents or hellenadicks, they remained at the original number of ten; and Pausanias says, that for ten months preceding the games, they dwelt together in a house appointed for them, and called from them, hellanodiceum. By the most scrupulous attention, they did every thing to qualify themselves for being deservedly the judges of *all Greece;* to which end they were patiently instructed by officers called guardians of the laws, and they attended every day in the gymnasium, upon the preparatory exercises of all those who were admitted as candidates, and who entered their names also ten months before, and exercised during a part, not the whole, of this time, in preparing themselves for the combat. Being exposed to the severest scrutiny, the judges had by these means frequent opportunities of trying the skill of the combatants, and also of exercising their own judgment; and both prepared themselves for the praise or censure of an awful tribunal, and a numerous assembly, whose censure could only be escaped by the most exact impartiality on the part of the judges, and the most sincere and earnest efforts for superiority on that of the competitors. In addition, the judges swore a solemn oath before the statue of Jupiter, upon their finishing the examination, to act according to the strictest equitiy; and to all these precautions against human frailty, liberty of appeal to the senate at Elis was allowed to any one who felt aggrieved. The judges had also the power of excommunicating whole nations. Once an Athenian found guilty of corruption was fined, and refused to pay. The Athenians sanctioned his refusal, and were instantly excluded from all the games, till they repented and paid the penalty. When the Lacedæmonians were impertinent, other nations took up arms, and compelled them to submission. Such power had a wonderful effect on all the nations of Greece.

As the time approached, the candidates were rigorously examined as to their virtuous descent, and their own moral life; and when they passed in public review down the stadium, a herald demanded with a loud voice, "Is there any one who can accuse this man of any crime? is he a robber? is he a slave? is he wicked or in any way depraved?" Themistocles once stood up at the ceremony and objected to Hiero, king of Syracuse, because he was a *tyrant*, a name odious to the democracies of Greece; and there could not be a stronger evidence of their utter detestation of the name, than refusing to admit a king to contend because he was a tyrant; thus placing him upon a level with a slave, who could not by law be admitted. The candidates having passed in public review with honour, were then sworn, that they had done all which was required by law; and marching to the stadium, attended by their friends, connexions, and families, who encouraged them to do their best, and appealed to the gods to smile on their exertions, they were left for the fight. And being thus thought worthy of the contest, even defeat was considered by them as an evidence of their honour. The olive crowns and palm branches were placed before their eyes on beautiful tripods, to excite their utmost exertions, and when victorious it was announced by proclamation; they were crowned by the heralds, and then led along, preceded by trumpets, their names being shouted aloud throughout the vast assembly; and on

[1] Lib. viii. c. 31.

[2] See West's *Pindar*.

their return to their native city, they entered through a breach in the wall, drawn in a chariot. And such was the high feeling engendered by these judicious excitements, that even Alexander himself was refused permission to contend, because he was a barbarian, nor was he allowed until he had proved his ancient descent at Argolis.[1] "In the republic of the fine arts," says the catalogue to the designs for a National Gallery, "competition is the great source of excellence; but so to frame institutions, and invite competition as to secure all the attainable talent, and so to form a tribunal as to derive all benefit for the public, and to do justice to the competitor, have been matters of great difficulty in all ages and all countries."

The whole history of ancient art shews the estimation in which the unsophisticated judgment of the public was held. Aristotle[2] says, "The multitude is the surest judge of the productions of art;" "If you do not get the applause of the public," says some one else, "what celebrity can you attain?" and Cicero[3] makes the public the supreme judge. Thus then, no one ought to wonder at the perfection of Greek genius in every thing, stimulated as it was by these secondary causes, and the one acting upon the other, in a climate adapted in every way for comfort, for health, and for convenience. The Greeks were men like ourselves, not larger as their arms prove, and not handsomer, for there exist as fine forms in either sex, in Great Britain, as ever graced the atelier of Zeuxis; indeed Cicero complains of the plainness of the Athenians. When genius and secondary causes unite, as they sometimes do, then such men as Pericles and Alexander, and Polygnotus, Zeuxis, and Apelles, are the result; for all the Olympic games, and Greek tribunals, could never have made Hudson Apelles, nor Caligula the benevolent Howard. "If any thing were wanting," says Flaxman, "to convince us of the high estimation painting was held in by the Greeks, the facts alone, viz. that Plato studied it, and Socrates was a sculptor by profession, are enough. But nothing is wanting."

In ancient painting, we certainly owe more to Pliny than to any other author; though in point of exquisite tact for hitting at once the characters of the great geniuses in art, he is not to be compared to Quintilian. There is more discrimination in the short account Quintilian gives of the painters and sculptors, than in all the delightful connoisseur chitchat for which Pliny must ever be the leading favourite. Yet certainly his gossip and anecdotes are sometimes underrated by learned critics; for in two instances of gossip, about the partridges and grapes of Zeuxis and Protogenes, and the contest of Apelles and Protogenes very deep principles of Greek form and Greek imitation may be settled. Painting is said by Pliny to have existed before the foundation of Rome in Italy, as illustrated by designs on the walls at Ardea, Lanuvium, and Cœre. This is always mentioned with a sort of doubt by antiquarians, who suspect that to the arrival of Demaratus from Corinth, the father of Tarquin, king of Rome, Italy owes her first knowledge of painting; but it has been shewn that this cannot be so, if pictures were executed in Italy before Rome was founded. Pliny sneers at the Egyptians for boasting of the antiquity of their painting; whereas the Greeks equally deserve a sneer for believing that they had invented design.

Tabular and mural pictures; distemper and encaustic painting

The Greeks painted tabular pictures on wood, and mural pictures on walls. The materials were either encaustic or wax painting, and distemper or glue-painting. In encaustic on wood, they painted with a metal point called *stylus*; in distemper they painted with brushes, and in encaustic on walls they also used brushes. Tabular pictures were prepared with a ground of wax, and the composition was drawn in with a *stylus* or point as we draw upon an etching ground with a needle. At a sale of antiquities in London there was a regular Greek tablet with a wax ground, a stylus attached to it as boys hang slate-pencils to their slates, and a sentence of Greek actually half-cut. The word γραφω being used for painting, design, or writing, makes the instrument the same in either case. This tablet was like a slate; the middle had been planed smooth, and the frame was left round it. The progress of the Greeks is very interesting, and shews how the mind gradually advances to the imitation of reality, and rests impatiently on mere outline, as a representation of nature. After a certain time, the early artists, when they had drawn an outline, ventured to colour it inside with black. This mode of imitation was called σκιαγραφια, and the paintings σκιαγραμματα, or skiagrams, from σκια shade, and γραφω to draw. Our black profiles and whole figures seen in shop windows, are the skiagrams of the ancient Greeks. This was hailed as a great step, and the painter who could fill up a face or a figure with black was regarded as a man eminent in art. After a little came the genius with more extended views, who invented the μονογραμμα or monogram from μονος only, and γραφω, to draw; that is, to define *by line only*, an outline without a shade. Next came the man who had the nerve to try a *positive colour*. Pliny has preserved his name, Cleophantus of Corinth; he ground up a red brick,[4] and therefore the Greeks claimed the invention of colour, although the Chaldæans had painted men red on the walls of Babylon, and so had the Egyptians on their tombs, nearly a thousand years before them. This discovery was called μονοχρωμα, or monochrom, single-coloured from μονος alone and χρωμα colour, and this was their first attempt at imitating flesh.[5] Next came the white ground (the *gesso* of the Italians and lime and plaster of the Egyptians) covered with wax. From one colour, naturally enough came the others; for if brick produced red, earths, burned or natural, would produce other colours, and polychrom, from πολυς many, and χρωμα colour, was formed.

The art having now discovered its materials, soon advanced steadily and gloriously to excellence. "How long the brush assisted only the cestrum, and when it superseded it," says Fuseli,[6] "cannot be ascertained; it cannot be proved, that it ever entirely superseded it, and there is every reason to believe they were always combined." It has been contested that painting was not known in Homer's time, because he speaks not of art; but what would be said of any man who argued that painting was not known in Milton's time, because *he* did not speak of it. Homer speaks of *painting ships*, and Milton alludes to "the *painted stoa*;" but colouring and design must have been known from the shield of Achilles, and the tapestries of Helen and Andromache, if the walls of Thebes and those of Babylon, had not settled the question. Troy was taken 1184 before Christ; but painting flourished in Egypt 1900 years before our era, that is, 716 years before Troy was taken, and 993 years before the era of Homer.

The nature of distemper and encaustic painting amongst the Greeks involves one or two questions interesting to artists. Their distemper was our tempera, and consisted in dissolving colour in water, and mixing it with glue; and though in Pliny, glue is only mentioned once, and that in conjunction with *(tectores)* plasterers, it is evidently to be inferred from the brushes used in its practice, that tempera intensely varnished was the general practice of the fabulous painters, and encaustics the exception. On all encaustic pictures, the Greeks put (ἐνεκαυσεν) "burnt in;" and what justified them in doing so? Merely the general application of fire to melt wax, or a particular mode of practice. Was the cestrum or stylus heated, whilst finishing the work, after the wax had been laid on? or was any actual

[1] See *Notes on West's Pindar*.
[2] *De Republicâ*, iii. c. 7.
[3] *De Oratore*, c. 49.
[4] Testa, ut ferunt, trita, Plin. lib. xxxv.
[5] Μονοχρωματων dictum. ibid.
[6] Fuzeli, Lecture first.

heat applied to amalgamate the colour in the conclusion, which justified such a term? or was the wax actually melted and used whilst boiling? Pliny says, that there were certain colours which would not stand without varnish; and that after they were laid on walls and dry, they were varnished with a mixture of warm punic wax and oil. Every Greek artist had his chafing-dish or καυτηριον; and when the varnish was dry, it was heated by fire from the chafing-dish "usque ad sudorem," *until it sweated*, when it was rubbed with wax candles, and polished with white napkins. This method the Greeks called καυσις[1] or the burning mode; and why might it not be applied as well to encaustic pictures, when finished either on wood, copper, walls, or stone, thus harmonizing and judiciously amalgamating fierce execution or distinct touches, and authorising the word ἐνεκαυσεν being put after the artist's name?

All the artists in Europe know well how often they use a vehicle[2] for a varnish, and a varnish for a vehicle in practice; and hence it is too absurd to doubt for a moment, that any Greek painter who had once used oil and wax as a varnish, would not use it as a vehicle at the first opportunity. Pliny infers, that "ceris pingere," to paint with waxes (coloured) and "picturam inurere," to burn in the picture, were *the same methods*. "There were anciently," he adds, "two methods, one *cerâ*, with wax, and another on ivory with a cestrum; then came a third, boiling the wax and painting ships at once with it, which was a lasting mode, so that neither sea, wind, nor sun destroyed it." It appears from another passage, that the ships were painted in the same way[3] as pictures which were burnt in. "Waxes are tinted with these colours for pictures which are burnt in; a different manner of painting from that employed on walls, but like that (of waxes tinted) employed for painting ships." Were tinted waxes applied hot? From this it may be inferred that they were.

Encaustic painting may be divided into four methods: 1st, mixing the colours with wax, and thinning them at the moment of painting with a liquid; 2d, placing wax in colours on the ivory, distinctly like mosaic, and uniting them by working them over with a heated cestrum; 3d, boiling the wax and using it hot; and, 4thly, softening the whole picture after completion, by heating it with a chaffing-dish or cauterium. Both Pliny and Vitruvius describe this last method of varnishing; and it is curious to contrast their relative descriptions. Pliny is rapid, careless, general, desultory, as if talking at a party; Vitruvius, accurate, mathematical, careful, and architectural, as if every word was a brick, that must be poised and balanced. Pliny says you must liquefy punic wax with oil,[4] and rub it with a candle and napkins. Vitruvius says, after your wall is dry and smooth, liquefy punic wax, *paulo*, a little by fire, then *temper* it with oil. In Pliny the *paulo* is left out, and so is the fire; but Vitruvius guides you to the *degree*, which is every thing in the practice of the art of painting. The *paulo*, therefore, is invaluable; do not boil, but heat your wax, then liquefy it, then varnish, then when dry heat it with a chaffing-dish and rub it smooth. To artists this practice is beautiful, and though oil-painting was supposed to be unknown to the Greeks, this was very near the point, and if used by Polygnotus at Delphi or Thespiæ, would have justified the term *burnt in*, without the use of the cestrum.

It is not settled by Pliny who first discovered encaustic painting; it is not known, he says, whether Aristides may have invented it, or Praxiteles completed it. But there existed on the walls encaustic paintings by the old painters Polygnotus and Nicanor; Lysippus at Ægina put his name to his tabular works with ἐνεκαυσεν; Pamphilus the great master of Pausias, did not practice it exclusively; and Pausias was the first in this art. Pausias, Pliny adds, repaired the walls of Thespiæ, painted by Polygnotus, but being obliged to use the brush, failed, because he handled an instrument which he was not accustomed to. It appears, however, that the walls of Thespiæ were painted in encaustic by Polygnotus, and with the brush; or Pausias, the greatest encaustic painter, would not have been employed to repair them, nor would he have gone out of the way to use the brush, if Polygnotus had used the cestrum. But Pausias failed, because the brush was not his instrument; therefore encaustic on walls was not worked with the cestrum, as it was on tablets, and the burning in on tablets was not of the same nature as that on walls. That the brush and the cestrum were totally different in practice there is no doubt; but that there was ever a time when the brush was not used in painting is absurd; and Pliny is evidently wrong in saying it was the last method.

It stands to reason that to paint ships was the earliest necessity of navigation. The ark was pitched inside and outside (Gen. vii. 14). Pitch melted is in fact like wax or oil; and how was it to be equally spread over so vast a surface except by brushes? In fact, amongst the Egyptian antiquities imported of late years, brushes have been abundant. Thus the Greeks painted on walls, wood, stone, ivory, copper, and canvass; on walls it was *mural painting*, and on either of the other materials, *tabular painting*.[5]

There is another question which remains to be settled before touching on the great artists and their works: Did the Greeks paint in fresco? The belief has been that they did. Vasari affirms it; but Letronne certainly establishes the suspicion that they did not, except in a few ornamental parts of architecture, and that stucco was more in practice. In fresco the colours are placed on wet mortar, and become a part of it. In stucco the colours do not become a part, and can be separated. Certain colours are destroyed by contact with lime, and yet those colours which fresco would have ruined, *are always found on ancient painted walls*.

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[1] It is clear that *fire* was always an important part in an encaustic painting, because Philiscus painted a painter's room (atelier) with a little boy *blowing the fire*. Pliny, xxxv.

[2] Vehicle, as distinct from varnish, means the liquid you paint with; varnish, the liquid you put over the work, when done, to preserve it.

[3] "Ceræ tinguntur iisdem coloribus, ad eas picturas, quæ inuruntur; alieno parietibus genere, sed classibus familiari."

[4] That Reynolds introduced wax into British art from this passage, there is no doubt.

[5] At this moment there is a dispute raging in France and Germany whether tabular painting was or was not the principal practice of the ancients, and whether mural painting was ever practised to any great extent. Letronne says cloth was not used *anciently* to paint on, and that Pliny thinks the man mad who painted Nero on cloth one hundred and twenty feet high; but the madness insinuated does not apply to the *cloth or canvass*, but to the *absurdity* of a portrait one hundred and twenty feet high in cloth. Why should canvass be only *once* used in antiquity, and never before or after till the middle ages? Is this likely? As a curious specimen of the blind violence of party, the friends of one of the combatants, Letronne, have written him from Athens, that in the temple of Theseus they have discovered by candle-light round the upper part of the wall, *actual contours* of the works of Polygnotus *cut in on the plaster with the cestrum*, the colours having been picked out by the early Christians; thus proving that Letronne is decidedly right as to his theory of painting on walls. Yet would it be believed, that the friends of his opponent, Raoul-Rochette, have also written him that they *do not see a single contour cut in*, but that they have discovered a *sinking-in* of the plaster as if fitted to receive tabular works which were let into the walls; and thus the theory of Raoul-Rochette, viz. that pictures were scarcely ever painted on walls, but nearly always on wood, *is right*, whilst the former gentlemen assert that there are contours on the walls. But the theory of M. Letronne *is also right*; for the ancients painted on walls as well as wood; and though Pliny says that the greatest glory was obtained by easel pictures, he affirms that there were also pictures on walls, because in giving one of his reasons for preferring tabular pictures, he says pictures on walls cannot be saved in case of fire, *(ex incendiis rapi non possunt)*, and that he prefers tabular pictures. If pictures had not been painted on walls as well as on wood, how could he have illustrated his preference?

Letronne says, that there does not exist a well authenticated evidence of fresco, except as mere ornament in ceilings.

Having thus laid before the reader the different modes of Greek practice, without which no subsequent account of their arts or artists would have been intelligible, it is time to say something of the artists themselves, who practised these various modes of imitating nature. Of their different methods, their white grounds descended to them from the eastern nations, and have come to us through the middle ages. Some of their colours we use now, and for some we have substitutes as good. If their principles were as easily attainable as their colours, we should have very little to desire.

Ancient Greek artists.

In the earliest state of Greek art, Philocles from Egypt, and Cleanthes from Corinth, were the inventors of outline, and Ardices from Corinth, and Telephanes from Sicyon, the first who put it in practice, without any colour. To this early period may be applied the accusation of Ælian,[1] that the artists were obliged to write underneath their wretched illustrations, "This is a bull, this is a horse, this is a tree." The next were single-colour painters, or monochromatists, as Hygiomon and others. Now the sexes began to be distinguished, when Cimon the Cleonean had energy to attempt the imitation of every thing. He it was who invented fore-shortening, and drawing things at an angle.[2] He it was who had courage to vary the characters and forms of heads, to make them looking up, looking down, and looking behind; he articulated his joints, shewed the veins and muscles, and gave undulation and folds to his draperies. Panænus, Phidias's brother, painted the shield of Minerva at Elis, and also the battle of Marathon; and so much had the knowledge of colour and art advanced, that portraits of the great leaders, Miltiades, Callimachus, and Cynegyras, on the part of the Greeks, and of Datis and Artaphernes, on that of the barbarians, were introduced, and known by the spectators. It was at this period that the glorious contests for victory in art were begun at Corinth and Delphi; and Panænus was conquered by Timagoras of Chalcis, who commemorated his victory by a poem; "though I doubt not," says Pliny, "there is some chronological error."

The Greek national and monumental painter Polygnotus, flourished at this period or before it. He seems to have been really a great man, and to have possessed a mighty soul. He was born in Thasos, an island in the Ægean Sea; and his works seem all to have been national, votive offerings of cities and his country. He was worthy of the finest period of Greece, and met his noble patrons by a suitable return; he was one of those beings who are born for the time or beyond it, and of whom the time is in want, or for whom it is not enough advanced. He first clothed lovely women in light and floating draperies, adorned their beautiful heads with rich turbans, and thus advanced the art immensely. In expression of face he ventured to make the mouth of beauty smile, and thus softened, by shewing the teeth, the ancient rigidity of his predecessors. He painted gratuitously the Hall at Delphi, and the Portico at Athens, called Ποικιλη, thus offering a contrast to Micon who was paid. Such conduct was immediately judged worthy to be commemorated by the highest authority in Greece, the Amphictyonic Council, who ordered that Polygnotus should henceforth be maintained at the expence of Greece. Pliny has certainly not said enough of Polygnotus, whose great work at Delphi, described by Pausanias, proves him to have had colour in a high degree, imagination in the highest, and all which, according to Aristotle, forms the most important requisite in the language of painting. His work at Delphi was executed by order of the Cnidians, who had a treasure there, and had also built a stadium. Besides this building, they employed Polygnotus to adorn the great Hall, leaving him the choice of subjects; and as Neoptolemus, the son of Achilles, was murdered and had a tomb near the spot, these subjects related to the Trojan war.

It is supposed that because Pausanias describes one thing as above another, composition was little known, and that there were several subjects in one plane. But any one might describe the Cartoons at Hampton Court in the same way, and make a reader, who had never seen them, believe that one figure was above another, and several subjects too. Might not one say, "*Above* Pythagoras in Raffaelle's *School of Athens*, is Alcibiades listening to Socrates;" but because they are *above* one another, that is no proof that they do not *retire*. Aristotle settles his high rank better than Pliny or Quintilian. "Polygnotus," says he, "made men *better* than they are, Pauson worse than they are, and Dionysius the same as they are."[3] Polygnotus, therefore, expressed the leading points of the species man, and cleared the accidental from the superfluous. Cimabue did not do this, nor Massaccio, nor Giotto; but Raffaelle and Michel Angelo did; and when this is done, in painting or sculpture, the component parts of art must be equally advanced. Besides, when did Polygnotus flourish? Between the 84th and 90th Olympiad. The Parthenon must have been built; the beauties of Phidias's immortal hand must have been executed, such as we see them in the Theseus, Ilyssus, metopes and friese of the Elgin marbles. And could any painter be a Goth in composition, when such knowledge of the art is visible in these perfect wonders? Polygnotus put the names to many of his figures; Annibale Caracci put "genus unde Latinum" to Venus and Anchises; Raffaelle gilded his glories; but what argument is that against the genius of either? The power of Polygnotus in painting the dæmon Eurynome, with a skin the colour of a blue-bottle fly, shews the truth of his imagination, as well as his power of observation and imitation. Polygnotus was a great genius, worthy of his age; and the "simplex color," applied by Quintilian to his works, only proves the purity of his taste in using it.[4]

Simplicity is not barbarism, any more than gorgeousness is true taste. About the 90th Olympiad the light began to dawn and to give promise of a glorious sunrise. Aglaophon, Cephissodonus, Phrylus, and Evenor, the father of Parrhasius, and preceptor of the greatest painters, appeared. These were all celebrated in their day; but one of the most important reformers was Apollodorus the Athenian, who flourished in the 93d Olympiad. He was the first, according to

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[1] Ælian, lib. x. chap. xii.

[2] Catagrapha invenit, hoc est, obliquas imagines et varie formare voltus, respicientesque, suspicientes vel despicientes. Fuzeli says *catagrapha* means *profiles*; but how could he *invent* profiles when *profiles* are the characteristics of the *earliest* art? At first all art is profile; but Cimon was a reformer. To draw downwards he invented oblique views, and varied the views of the head and face, looking behind, looking up, and looking down. Fuzeli says *catagrapha* means profile; but profiles are not oblique representations but sections of the figure and face, in the same sense as architectural sections, that is, equal halves. The "obliquæ imagines," are *angular views*, seeing things at an angle; the passage is directly illustrated by the circumstances, that he made his heads looking behind, &c.; and how can a head looking behind be a *profile?* In some places it may mean so; in Pausanias, κατα in radical meaning is *downwards*, as if the eye looked at the top of the head to the feet, which is *fore-shortening*.

[3] Aristotle, *Poetics*.

[4] Hardouin's *Pliny*, lib. xii. c. 10, p. 893. Clari Pictores fuisse dicuntur Polygnotus, atque Aglaophon; quorum *simplex color* tam sui studiosus adhuc habet," etc. Now the *simplex color* of Polygnotus and Aglaophon was not *one colour*, like monochroms, but modesty in the arrangement of the *three* colours, red, yellow, and black, without blue. How then could the monochrom apply to Polygnotus, whose works at Thespiæ, Delphi, and the Poikile at Athens, were painted in all the variety these three colours could produce, and not confined to *one* colour?

Painting.

Pliny, who expressed the *species;* and he was also the first who did honour to the glory of the pencil. But, after Phidias, Panœnus, Micon, and Polygnotus, one is inclined to question whether he was the first who expressed the species. Phidias, in the opinion of the ancients, was the greatest artist in sculpture. Plato says that Phidias was "skilled in beauty;" but to be skilful in beauty, argues the power of expressing the species, and a perfect knowledge of the construction; for beauty is the last operation, and is based upon the first. How then Apollodorus could have expressed the species better than Phidias or Polygnotus, it would perhaps have puzzled Pliny to explain. However, let us take what the gods have spared, and be grateful. "His, is the adoring priest," says Pliny, "and Ajax defying the lightning at Pergamus; nor was any tablet worth looking at before." That may be. The previous works were monumental, national, or mural, painted with brushes, and bold in execution. Tabular painting may have been a more delicate workmanship; but it is not to be compared with the true epic, any more than the highly-wrought easel pictures of Raffaelle, are to be compared with his frescos.

Ancient Greek painters.

"The doors," says Pliny, "that Apollodorus had opened, Zeuxis boldly marched through, about the 95th Olympiad; daring every thing the pencil could do, and carrying it to the greatest glory." Some place him in the 89th Olympiad; but this is a mistake. Demophilus or Naseas was his master. Apollodorus became envious of Zeuxis, because the latter improved upon the style he had introduced, and wrote a lampoon. Zeuxis became very rich, grew very haughty, and always appeared at the Olympic games in a purple robe, with his name in gold letters on the border. So high was his opinion of his own pictures, that, thinking no money could equal their value, he gave them away. From this feeling, he presented an Alcmena to the Agrigentines, and a Pan to Archelaus; he also painted a Penelope, in which her moral beauty of character was visible, and an athlete, so much to his own delight, that he wrote underneath, "It is easier to criticise than to execute." His great works were Jupiter and all the gods, and Hercules strangling the serpents. He was censured for large heads and violent markings, but otherwise he was strictly correct. Pliny varies his history with current stories, and we can almost get at the principles of Greek art from them as well as from the account of the art itself. Current stories and proverbs should never be disregarded; for, if not true, they may be taken as inventions characteristic of the parties, or they would never have been believed. The Agrigentines, says Pliny, ordered a picture for a temple of Juno Lucinia, and they allowed the painter to select the finest girls as models. Cicero[1] says it was the Crotoniates who employed him; and as Zeuxis always studied nature, the most beautiful girls were ordered by government to come to him, and having selected five, he then painted his Helen. Zeuxis made his sketches in black and white *(pinxit et monochromata ex albo)* or of a single colour heightened by white. His contemporaries and rivals were Timanthes, Androcydes, Eupompus, and Parrhasius. The contest of the last with Zeuxis, in which the one deceived the birds by grapes, and Parrhasius Zeuxis himself by his curtain, contains the great principle of Greek art, viz. *That the most perfect imitation of reality was not incompatible with the highest style.* Antiquaries are disposed to laugh at these stories as beneath the dignity of belief; but artists know well enough, that, so far from being unworthy of credit, all the stories of Pliny and Ælian tend more or less to illustrate a principle. Zeuxis painted a boy and grapes, and the birds flew at the fruit; but his rival observed that, if the boy had been equal to the grapes, the birds would have been frightened. Zeuxis was a great painter and discovered the principles of light and shadow.

After Zeuxis came Parrhasius, "liquidis ille coloribus,"[2] who was born at Ephesus, and celebrated for great excellence. He first gave correct proportions to painting; airs to the head, elegance to the hair, and beauty to the countenance. By the acknowledgment of all artists, the manner in which he *lost* the contours of his forms, was exquisite. Many people can execute the parts of which the middle of things is composed; but few can finish the boundaries of objects as if the substance was round, and did not end with the contour which defined it; thus giving one an idea as if something was concealed, and exciting the imagination to conceive what the eye did not see. This excellence Xenocrates, and Antigonus, who wrote on painting, conceded to Parrhasius; and not this excellence alone, but also many others. The best idea than can be given to the moderns of the works of Parrhasius, is by referring them to the pictures of Corregio, of which this is the great excellence. Parrhasius appears also to have had the same defect; for he softened the centres of his figures, and gave them too much pulpiness for the heroic. There remained, in Pliny's time, sketches of subjects, and of hands and feet, from which artists learned a great deal. He contrived in a picture to paint the people of Athens, and to give a true idea of their variable character; humble yet vain-glorious, timid yet ferocious;—and all these contrasts he expressed with great power. But Parrhasius disgraced his genius by yielding to what Johnson calls "the frigid villany of studied lewdness," and sacrificed his noble art to pander to the beastly appetites of the debauched; in fact, Tiberius kept one of his licentious pictures in his bed-room, namely, that of Meleager and Atalanta. But whatever may have been the habits of antiquity, and however indecencies may have been connected with religion, it is clear the greatest men did not approve of such prostitution of talent. Aristotle censures the practice, and warns tutors to guard their pupils from such corruptions.

Timanthes followed, the great painter of the sacrifice of Iphigenia in Aulis. No picture had more reputation for touching art and delicacy than this. After exhausting expression in all the principal agents, the artist covered the face of the father, not daring to trust his hand to attempt imitation, and leaving every spectator to imagine an agony of his own. As Euripides has the same incident, Fuzeli thinks the honour of being the first inventor is due to Timanthes. In the death of Germanicus, Poussin hid the face of his wife. Timanthes seems to have been ingenious in his inventions; to give the idea of great size to a sleeping Cyclops, he introduced two satyrs trying to span his thumb. Pliny adds, that there was a head painted by him in the Temple of Peace at Rome, and which was a perfect specimen of art.

Euxenides taught Aristides, the great master of expression, and Eupompus taught Pamphilus, who was the master of Apelles, a name synonymous with perfection in finish, but not for invention like Zeuxis, monumental commemorations like Polygnotus, composition like Amphion, or expression like Aristides. No; Apelles was the deity of tabular pictures, the greatest glory of the art in Pliny's mind, but not in the minds of those who see beyond the range of a dining-parlour. Eupompus painted a victor with a palm branch in his hand; and such was his influence in Greece, that he was allowed to divide painting into three schools, viz. the Ionian, Sicyonian, and Athenian. Pamphilus was a Macedonian, who combined literature with painting and made it a principle of tuition, that no man could be great in either who was not a mathematician; for he denied that without geometry art could be perfected. He taught nobody under a talent, which both Apelles and Melanthus paid. So great was the influence of this distinguished man, that first at Sicyon, and afterwards in all Greece, he got it established as a principle of education, that all clever boys should be taught on tablets the art of delineating, which is the foundation of

[1] De Invent. lib. 2. chap. x.

[2] Horace.

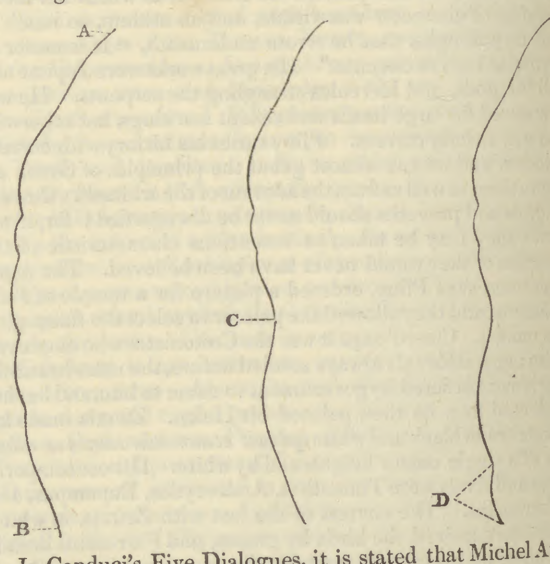
painting. He considered this art as the first that should be taught in a liberal education. Slaves were prohibited the exercise of design; which was an absurd law, because in literature it would have prevented Æsop or Terence from developing their genius. What right have any creatures, who are obliged to eat and sleep like the meanest slave, to pass a law to prohibit the exercise of any natural talent, if the Almighty has not disdained to think one worthy of being so gifted? The consequence of this was, that no slave ever distinguished himself in the arts.

About the 107th Olympiad, after Echion and Theramichus, came the god of high finish and grace, Apelles. His style is always the precursor of decay. First came a race in art, amongst whom invention, expression, form, colour, and execution, in a series of pictures intended to illustrate a principle were enough, provided the principle was expressed. These were the *monumental geniuses*. But when the art becomes national and glorious, the noble and the opulent become ambitious to share the glory with their country; and the art sinks to the humble office of adorning apartments. As is the demand, such will be the supply; and the genius of a country is thus turned from national objects and public commemorations to private sympathies and domestic pleasures. At this period of Greek taste appeared Apelles; refined, accomplished, delicate, devoting his whole soul to single perfections equally adapted for a temple or a palace, and patronised equally by his sovereign and the people. Educated by Pamphilus, he was grounded to the very foundation, and consequently drew, as Burke says to Barry, with "the last degree of perfection." Apelles, Aristides, Nichomachus, and Protogenes, were the most distinguished artists of Alexander's time.

Apelles wrote copiously on his art, and explained its principles. His treatises were extant in Pliny's time, and even in that of Suidas,[1] who speaks of them; and as they were probably illustrated with designs, the loss is much to be deplored. Beauty was the leading feature of his style, as well as of that of the greatest painters of the same period. In grace he defied competition; and this explains the secret of his triumph. "I know when to leave off," said he, "which is a great art; Protogenes does not. Over-working is injurious." He was a very generous man, and acknowledged when others were superior to him; observing that Amphion[2] was a better composer, and Asclepiadorus more correct in proportion. Amongst all the stories of Pliny, the most delightful is that of Apelles and Protogenes, which seems to be an authentic fact; and even if it were not, it would illustrate the principles of Grecian art. Protogenes lived at Rhodes and Apelles sailed to see him. Having landed, he called, and found the artist "not at home." Being shewn by an old woman into his painting-room, he found a tablet with its wax ground ready for a picture, and taking up a brush, drew an exquisite line in colour down the tablet. Protogenes having returned, was shewn what had happened; and, contemplating the beauty of the form, he said it must be Apelles, as nobody else could draw so perfect a work. He then took the brush and drew another still more refined, saying, if the stranger call again, shew him this, and say that that is what he is seeking. Apelles returned, and blushing to see himself outdone, again took a brush and drew a third, leaving nothing to be exceeded in refinement, *(nullum relinquens amplius subtilitati locum.)* Protogenes when he saw this immediately sought his visitor, saying that he could carry the line no further. The tablet with these lines upon it, was considered by all the Greek artists as a miracle of drawing. After the death of Apelles and Protogenes, and the conquest of the Romans, it was preserved in the palace of the Cæsars on the Palatine hill, where it was seen by Pliny containing nothing but three fleeting lines, *(tres lineas effugientes)* and yet superior to all that was to be found in the finest works. Unfortunately it was burned at the destruction of the palace.

Now comes the question, what were these lines which could thus speak to artists who had never seen each other, the common language of a common code of law for design. "*Secuit lineas*" does not mean actually to cut the lines in two, but in the technical idiom of English artists, to strike a line. It was not the metal cestrum, but the hair brush, and therefore *cut* in this sense could not have been meant. To *cut* with a brush means to design with an air of power. Three lines varied in shape would mean nothing, if nothing was expressed; but if some known contour of the body was taken in repose, three variations of its position without alteration would be as much as could be expected in the contour. Suppose that Apelles drew a line from the clavicle A to the pubis B of a body in profile, shaping all the parts as he went correctly like fig. 1. Next, suppose that Protogenes having come in saw the line, and knew that in finely-formed men, the stomach, from great exercise and temperate living, becomes small; the contour would curve in at C, so that that portion of the *rectus* muscle would retire, as in many of the Greek statues. He would then take the same contour, draw it again on the wax tablet, and make this variation. Again, suppose that Apelles returned and on seeing himself vanquished, took the brush and drew the same contour, allowing the variation of Protogenes, but remembering that in powerful men, the *pyramidalis* D, fig. 3, arising from the *pubis* and going into the *rectus*, makes another and the last variation. Then Protogenes returning, and seeing that nothing more could be done unless the body was altered in position, he would acknowledge the line to be completed.

Fig. 1. Fig. 2. Fig 3



In Conduci's Five Dialogues, it is stated that Michel Angelo thought it must have been a contour of some part of the body. Now. this singular contest would be felt by all artists as one of the greatest utility. It would be wondered at by connoisseurs, and would illustrate a great principle; namely, that a knowledge of construction was the basis of correct design and the foundation of all beauty.

It was the continual practice of this eminent man to do something every day, whatever happened; and hence the proverb, "No day without a line." If artists were to write

[1] About the year 1100 of our era.

[2] Junius *(de Pictura Veterum)* only finds Amphion mentioned twice in ancient authors, and it is hence supposed that Echion would be a better reading.

this over their painting-room doors, it would not be without advantage. Rubens rose at four, and was in his painting till five in the afternoon, with occasional variations. All the greatest men of antiquity and of modern art, have been the most diligent and the most industrious. And here is the most celebrated of the tabular painters of antiquity afraid to let a day pass without the use of the pencil. Apelles used also to hide himself behind his works to hear the remarks of the public. This deference to the public voice evinced by sculptors, painters, and statesmen, is a beautiful proof of the sense and understanding of the time. Nothing was done in defiance of public taste, but every thing in conformity to its dictates; and though this does and often did lead to great injustice in political matters, in art the maxim is infallible.

Apelles of Cous excited envy enough, and notwithstanding his graceful manners, his tender heart, and his accomplished mind, when driven by stress of weather into Alexandria, the courtiers of Ptolemy, hating his superiority, and fearing his probable fortune, sent him a pretended invitation to sup with the king. Apelles went; the king felt astonished at the liberty, and sending to demand explanation, discovered the imposition. On inquiring if Apelles knew the person who had given him the invitation, he immediately sketched his face on the wall, and the king recognised the culprit. Courts, kings, and people can only judge of results. The infinite number of repeated acts, the *nulla dies sine linea*, the failures, the recoveries, the musings, the thinkings, that had taken place with the "cestrum cum lumine," they had not witnessed; therefore, knowing their utter incapacity to do as Apelles did, they concluded that he was a wonder, and he of course became a favourite. As an evidence of that peculiar tact by which such men are sure to please kings and nobility, namely, by the power of seizing the most agreeable expression of any sitter's face, however ugly, and rendering his very defects a cause of elegant concealment; he painted Antigonus, who had lost one eye, in profile, concealed his defective eye, and made him as graceful as if he were Alexander. This was the great secret of his fortunes, as it was that of Titian's, Vandyke's and Reynold's; and though not to be compared in point of taste or knowledge of the art, this was also the secret of the popularity of Lawrence, mere portrait painter as he was, and nothing more.

Polygnotus, Pausias, Aristides, Timanthes, Zeuxis, Parrhasius, Pamphilus, Euphranor, and Timomachus did not so completely gratify the vanity of their contemporaries, and were not such personal favourites as Apelles; for there is no gratitude equal to the gratitude of being successfully painted. Kings bow to the unknown power of having their momentary expressions observed, seized, transferred, and fixed for ages, and whilst colours and canvass last, carried on, for the admiration of a distant age, when the existing one is past and forgotten. What can equal the gratitude of a woman to have her beauty preserved, whilst she is in her bloom, for the admiration of her children when age has shrivelled her form, or misfortune destroyed her happiness? The world may be elevated, excited, roused, by the commemoration of the great deeds of ancestors or heroes; but no sympathy is ever excited, and no personal vanities are ever so happily gratified by any class of painters, as by the great portrait-painter. The degree of imagination required is not of that irresistible kind which forces him to leave the model before him, using it only to realise his own burning conceptions, so that all likeness of the *individual* is lost; he requires no more than to retain in his mind the best expression of the individual before him to identify it upon canvass. But it must be exactly like, or it is nothing. After the likeness is completed, the sitter will have no objection to the highest degree of embellishment. There the great portrait-painter shews the degree of *fancy* wanted, and he that embellishes most, without losing resemblance, will be the most welcomed, as Apelles was, by the world.

To put Apelles in comparison with Polygnotus is out of the question. Highly-wrought individual figures, little more than portraits of beautiful nature, cannot rank so high in the judgment, though they may in the delicate sympathies of the world. But that single terrific conception of the demon Eurynome, for which no prototype in nature could be found, that momentary blush which crimsoned his Cassandra,[1] Aristotle's praise that he made men better than they were, and Plato's ranking him with Phidias, settles the question of his greatness; and as a portrait expression must be seen before it can be done, and must be like or it is nothing, there is an end of the highest quality of human genius, invention. Indeed, whatever the vanity of the world may be inclined to feel, the greatest portrait painter is but an inferior artist.

The age of Polygnotus and Phidias was the meridian age of Greek art; and that of Apelles was the setting glory. From the latter period it sunk gradually as if nature had been exhausted by the previous effort. Such ages have never since been seen; such perfection had never been realized before, and never will be again; for in order to become such sculptors and painters, men must also become idolaters. But to return and conclude the notice of Apelles, this court-favourite of antiquity. Notwithstanding the education of Alexander by Aristotle, notwithstanding that ή γραφικη was a portion of his education, Alexander was little more than a glorious barbarian in art. He talked so absurdly in the painting-room of Apelles, that the artist was obliged to request that his majesty would be cautious, lest the boys should laugh as they ground their colours. Apelles may be considered as the Titian of Greek art, with the addition of all that vast knowledge of form, which every painter and every school was obliged to master. But the disposition to perfect single figures, and the acknowledgment that others exceeded him in composition, clearly point out the extent of his fertility. Though Pliny describes many beautiful pictures, his greatest are single figures. His Venus Anadyomene was the most celebrated of all his works; but being painted upon wood, it was destroyed by insects in the time of Augustus. He began another, and having completed it as far as the bosom, died; but although the contours were completed for finishing, nobody would venture to touch it, such was the extreme veneration entertained for him. By this description we see the nature of the Greek process; first, the ground, then the drawing in, next the impasto preparation, and then the completion part by part. He had got the picture finished as far as the bosom; and therefore to finish highly by degrees was his system. He was not deficient in expression, for he painted persons dying with great power. His imitation must have been perfect, for his painted horses are said to have made real horses neigh; and his colour must have been exquisite, for he glazed like the Venetian school. Pliny mentions him as one of those who painted with four colours; but this is a mistake; for it was in the age of Polygnotus that *blue* was not used. From a passage in Cicero,[2] it appears that that age was famous for "form and contour;" whereas, according to the same writer, *all* things were perfect in the works of Protogenes, Nichomachus, Echion, and Apelles.

Pliny is therefore right in saying that pictures which constituted the opulence of towns, were painted with four colours only; but he is not as clear as usual in regard to the period to which this observation applies. Quintilian, calling the colour of Polygnotus "simplex color," seems to indicate the absence of *blue*; whilst *red*, *yellow*, *black*, and *white* did not produce such gorgeous splendour as in the age of Apelles. Thus Quintilian, as well as Cicero, collaterally proves Pliny to be in part right. It is extraordinary that Reynolds did not

[1] Lucian.

[2] *Brutus*, c. 18.

Painting.

allude to the absence of blue in the enumeration of Pliny. Great depth, fine tone, simplicity, and modesty, can be obtained without blue, but never that tremendous magnificence produced by the contrast of the deep and awful azures of Titian. Though Polygnotus did not use blue, his black was made from vine-stalks and wine-lees,[1] which render black more blue than the ivory black of Apelles, which was discovered by him, and is used to this hour in Europe. There were several of the same name, but *Apelles Cous* distinguishes the great Apelles, as *Aristides Thebanus* does the great Aristides.

After this long account of the courtly, accomplished, and highly-wrought Apelles, there may be something interesting to allude to Aristides the "great master of expression," as Fuseli calls him. He was the first who painted deep human emotions, fierce passions, and distressing perturbations; but he was hard in colour, says Pliny, and not so harmonious as Apelles, probably like Raffaelle, the great Italian master of expression, in comparison with Titian. His finest picture was that of a mother dying from a wound which she had received in the sacking of her native city. Her infant was trying to reach the nipple with its boneless gums, whilst the mother, faint and exhausted, appeared struggling to save it from sucking, lest blood might mingle with its nourishment; a tender and affecting thought. Alexander was so touched by this picture at Thebes, when the city was taken, that he sent it to Pella.[2]

Protogenes was another of the great men of this time. It is indeed extraordinary to reflect how genius in art and literature seems always to come in clusters in every country. He was born at a small town on the coast of Asia Minor, subject to the Rhodians; and he got his living till he was fifty years old, in great poverty, painting beautiful ornaments for the prows of ships. He was not a man of fertile invention, and spent years over single works, which induced Apelles to say that he never knew when he had finished. His celebrated work was Talissus, which occupied him seven years. Titian took eight to paint the Pietro Martyre, and seven to finish the Last Supper for Charles V.;[3] and yet in Titian's works there is no appearance of over diligence. Pliny says he painted his pictures four times over, so that if one picture was destroyed another might be ready. Nothing shews so completely the exact degree of knowledge which Pliny had of art as this absurd conclusion from an admirable practice. Protogenes proceeded with his works as Titian did, by *stages;* and each stage was a separate impasto of colour, which helped the next till completed. Of this artist the story is told of his flinging his sponge at a dog's mouth in a rage, because he had vainly tried to hit breath coming out of it, and by that accident succeeding; a circumstance which shews that it was tempera painting, for a sponge would not have done for wax. Such a habit of daily application had Protogenes, that when Demetrius besieged Rhodes, he would not leave his painting-room, but proceeded daily in his studies amidst the noise of battering rams and catapultae. The king came often to visit him; and that part of the town where he worked was spared, and the picture thus finished was said to have *been done at the point of the sword.* Protogenes painted the mother of Aristotle; and the philosopher urged him to execute the battles of Alexander; but he was not a man of rapid conception or fertile invention for a series, and could not be moved.

It is curious to reflect, that all the great painters painted portraits; which proves that they thought it essential to that truth which was the foundation of their ideal beauty. Indeed, every great painter *should paint a portrait a month;* and if, like the Greeks, he has always nature for his works, he never can degenerate into manner.

Of the other painters, Asclepiodorus was celebrated for proportion; Nicomachus for rapidity of hand, and Theon for wild conceptions, "quas Græci vocant φαντασιας." Pliny places Theon amongst the herd, whilst Quintilian and Ælian place him amongst the illustrious, where he ought to be. He painted a single warrior dashing forward on the spectators; and collecting the public, he kept the picture behind a curtain, when in the midst of a blast of trumpets, the curtain was dropped, and the wonderful figure terrified the people. He also painted Orestes, distracted and insane, and proved himself a great and wild inventor. The three remaining great men of the fine period, were Pausias, Euphranor, and Timomachus. No passage has excited so much discussion as the well known one in Pliny, where he says, "nulla gloria artificum est, nisi qui *tabulas* pinxêre," as if he meant that the only glory in art consisted in tabular pictures, "πινακες," on wood, and that there was but little in monumental and mural efforts. Pliny, however, does not here contrast the tabular pictures of Apelles with the mural paintings of Polygnotus, but with the works of one Ludius, a Roman, a mere ornamental landscape-painter upon walls, like our Bond Street paper painters. This was much the fashion in Pliny's time, which he laments; and many examples of the same species may now be seen in Pompeii.

Having thus described the fancies and caprices by which the art had been degraded, Pliny turns to the highly beautiful tabular works of Apelles, and observes naturally enough; "This is not the thing; the glory of art and of artists consists in the Venus of Apelles, the mother of Aristides, the Ialysus of Protogenes, and not in this mechanical whim, which is not the glory and the end of painting." This, perhaps, is the explanation which he would give if he were alive and able to answer us. Is it not unjust then to take up such ground as M. Raoul-Rochette has done in France, and Payne Knight in England, and infer that there was no real glory in any other mode of painting? The ancients estimated mural painting at Delphi, as the Italians do in the Vatican. But they did not undervalue tabular painting, small pictures, encaustic, landscapes, or humour; they painted in every style and they excelled in all.

Pliny now proceeds to the encaustic painters, of whom Pausias and Euphranor appear to have been the greatest. Pausias was a master of foreshortening, as we learn from Pliny's description of a bull which he painted in front and projecting beyond the tablet. After Pausias came the Isthmian Euphranor, who wrote on symmetry and colour, painted great and small works, and delineated statues and animals. He said of his Theseus, that "it was real flesh, whilst that of Parrhasius had fed on roses." Then came Nicias who painted women beautifully, understood light and shadow, and was another pillar of art. Metrodorus was both a philosopher and a painter; and when the victorious Paulus desired Perseus to send him a philosopher to educate his children, and a painter to arrange his triumph, Metrodorus was despatched as a person capable of executing both tasks. Timomachus is the last of this splendid list whom it is necessary to mention. He died, like Apelles, leaving an important work unfinished.

Glory and decline of Greek art.

Such were the most illustrious men of the three finest periods of Greek painting. The first period of Greek art was that before Pericles; the second, or that of Pericles himself, was the finest, the highest, and the purest in painting, sculpture, and architecture; the third was the epoch

[1] See Pliny, lib. xxxv. The sea in the Venus Anadyomene is quoted as a proof that *blue* must have been used. But where is there any *blue* in Vandervelde? We do not think that a picture exists with *blue* in his sea.

[2] Raffaelle imitated this in his plague, where a fine youth is putting away an infant from a dying mother's bosom; but the utter wan of taste in making the boy hold his nose for fear of infection, renders the sentiment not pathetic but at once disgusting and ridiculous.

[3] See, in Ridolphi, Titian's letter to the emperor.

of Alexander, the most refined, but prophetic of the corruption followed; then came the subjugation of the Romans, when the noblest works of the Greeks were seized as tribute, or matters of right, and Italy was inundated by the productions of Greek talent.

Effects of the conquest of Greece.

This influx of foreign productions entirely suffocated native Italian genius. Greek productions became matters of property; and dealers sprung up who manufactured originals to supply the market of the rich collector. Galleries were formed to produce genius, which had sprung up from national demand without a single gallery or a single collection of any works, except the productions of their native soil. The most celebrated works were copied and re-copied by the Greeks in all parts of the Mediterranean. Horace alludes to this; and there can be no doubt whatever that the effect was to render all native attempts of the Romans and Etruscans no longer available. For not one great artist is named during the whole period of progressive decay from the Cæsars to Constantine; and the Romans or Latins never produced any talent worth consideration till the revival of art in Italy, after so many ages, in the fifteenth century. Then, the same principle operating, and the church and state demanding art as an assistant, outpoured an abundance of native talent, because there was a vent, as there had been before, in Greece, Egypt, and Chaldæa; and the genius of Rome, Florence, Pisa, and Venice, vindicated their long suppressed claims to originality. Amongst the illustrious Romans, Julius Cæsar seems to have been a magnificent collector; but whether, like Napoleon, he was also a magnificent patron of the talent of his time is not known. He bought Greek pictures, and presented them to Roman temples; but one work of native art, produced by native patronage, is more honour both to patron and to artist than a gallery of foreign pictures be they ever so divine.

Upon the whole, before tracing art from its decay to its revival, we cannot but acknowledge as evident, that a period of dearth in genius has generally succeeded in the world to one of prolific production. In painting and sculpture, secondary causes, such as the nature of the government, or the circumstances of the two arts being required for political purposes, may considerably facilitate the development of genius. But it is not so with the poet. He can give vent to his immortal thoughts in poverty or wretchedness, independently of the taste of the times, or the patronage of the state. Milton, in obscurity and blindness, wrote Paradise Lost; and Savage, in poverty and wretchedness, composed his Bastard in the streets, begging bits of paper as he walked, when he had more thoughts than his mind could contain, and thus, as effectually preserved them as if he had been bred in a palace, or had sheets of the finest *hot-pressed* to receive his lucubrations.[1]

Inferiority of the Roman school.

After the conquest of Greece, and the removal of art and artists to Rome, the genius of painting seems to have left the world. The Roman school of painting and sculpture is scarcely worth a single thought. In the last years of the republic the art sunk rapidly. Augustus tried to revive it; but though the pupils and descendants of the illustrious dead attempted to second his views, and though the writings of Apelles, Euphranor, and Pamphilus, were all in existence, and their principles known and acted upon, genius was nowhere to be found. That divine spark with its attendant whisper, unseen but not unheard, which ever attends the gifted who are born for great objects, whether it supported Columbus amidst the storms of the Atlantic, Alexander as he plunged into Asia, Napoleon as he rushed into Italy, Wellington at Waterloo, Michel Angelo when he painted the Sistine Chapel, Raffaelle when he entered the Vatican, or Phidias when he adorned the Parthenon; that supernatural, incomprehensible something, which inspires hope, "when the whole world seems adverse to desert," was gone from the earth like the glory which had blazed in the temple. All that the savage, splendid, imperial Romans could do, all the honours and riches they had to confer, were bestowed in vain. Architecture suited their savage vastness of mind better than painting; therefore architecture flourished, and Augustus was said "to have found Rome thatched, and left it marbled."

> Not Babylon
> Nor great Alcairo, such magnificence
> Equalled in all their glories, to enshrine
> Belus or Serapis[2] their gods, or seat
> Their kings, when Egypt with Assyria strove
> In wealth and luxury.

Claudius built a superb aqueduct, and Nero burned[3] and rebuilt a golden palace; but he could not replace the lines of Apelles and Protogenes, or the miracles of Timanthes and Aristides, which perished in the conflagration. Galba, Otho, and Vetellius were hurried through life and empire too rapidly for art; whilst Vespasian and Titus bewildered the Romans with their Cyclopean masses. Hadrian, himself an artist, endeavoured to recover art by indiscriminately encouraging Etruscans, Greeks, and Romans; "but such a medley of principle as their works displayed," says Agincourt,[4] "hastened the decay of art, and rendered the emperor hopeless of reviving it." The art thus went floundering on until Dioclesian, with all the gorgeous splendour of an eastern monarch, mingled together Roman, Greek, and oriental art, and corrupting all taste led to its extinction. It was between the reign of Commodus and that of Constantine, that those causes were generated which undermined the empire, and brought art, science, and literature into the chasm. Of forty emperors who, from the second to the fourth century had struggled for the diadem and obtained it, twenty had been murdered by the army and the people. "Ainsi" says Montesquieu "comme la grandeur de la république, fut fatale au gouvernement républicain, la grandeur de l'empire le fut à la vie des empéreurs."[5] Constantine's removal of the seat of empire did not so much begin the destruction of art as complete it; for previous causes, domestic and political, had been preparing the ruin for centuries before.

Age of Constantine.

Agincourt thinks that as far as art is concerned, too much has been attributed to this removal of the empire. But yet the first epoch of what may be called *modern art* in opposition to *ancient*, must date from the introduction of Christianity as a state religion, when the whole moral feelings of Greek and Romans took another turn in painting and sculpture. Although Constantine only grafted Christianity on Paganism, and founded more catholicism than Christianity, by meeting and uniting the prejudices of both Pagans and Christians; yet surely if genius could ever be created by patronage, the age of Constantine, and those of Charlemagne, and Louis XIV. ought to have rivalled those of Pericles and Julius. Such was the rage for splendour in this reign, that the quarries of Phrygian marble and of the isle of Proconnesus, were almost destroyed to furnish palaces for the emperor, his sons, and his ministers. Temples, palaces, forums, triumphal arches, colossal statues, an hippodrome, and eight public baths were built and adorned at once; and in addition, splendid commissions were given to the painters for pictures of Christ, the Virgin, the prophets, and the apostles. Rome, Naples, Capua, Antioch, Tyre, Jerusalem, and even Bethlehem, felt the effects of this mag-

[1] See Johnson's *Lives of the Poets*, art. Savage.

[2] In this beautiful passage, the immortal author has made the penult syllable of *Serapis* short, whereas it is in reality long, *Serāpis*; an error which could scarcely have been expected in one who was a great scholar as well as a great poet.

[3] Tacitus does not seem altogether to believe it.

[4] Agincourt, *Histoire de l'Art*, tom. i.

[5] *Décadence des Romains.*

Painting.

nificent employment; but what were the results to painting? Nothing, absolutely nothing, to guide anybody except the antiquary; and if any evidence were wanting to show that the genius and the patron must exist together, or the result will be nothing, the end of Constantine's splendour would abundantly supply it.

The moral character of ancient Greece was gone; the instinct of public glory was passed; their olive crowns, the adequate reward of talent on a great principle, were sneered at; and "Lucian," (as the author of the *Discours Historique* observes) "had already ridiculed this tribunal," which had listened with rapture to Herodotus, and crowned Aëtion for a fine picture, and which in its days of Marathonian glory, had done more than ever was done before or since in rousing human effort, mental and bodily, to its highest pitch of excellence. Luxury, indolence, vice, fanaticism, cant, sophistry, intrigue, and imposture, had supplanted the pure aspirations of patriotism and glory. "The great and the opulent," says Pliny and Vitruvius, "were fonder of gold and glitter than purity of design or pathos of expression, or perfection of form; overwhelmed with colours from all the countries of the earth, with double the advantages of Polygnotus, and Zeuxis, and Aristides," who painted with four only, "nulla nobilis pictura est." Of course, this is always the end, when the moral and national importance of painting is undervalued. When native art is despised, and spurious foreign productions are preferred; when connoisseurs of what *is past* abound, and connoisseurs of what *is passing* exist not; when painting is considered as a bauble or a bit of furniture, and painters share dignity with upholsterers and gilders, what wonder if "*nulla pictura*" is the cry?

Gold and vermillion being thus introduced upon the walls of palaces and preferred to beautiful art, in came arabesques. Claudius had before introduced Indian patterns and mosaic pictures, which had hitherto been kept for pavements, till Commodus, for the sake of a new sensation, had a portrait in his palace of Piscennius Niger,[1] painted in mosaic, which may be considered as the first picture of this description. When painting was in this staggering condition, Justinian gave it a final blow by ordering encaustic and distemper designs, as vulgar, to be banished from ceilings and walls, and mosaic, marble, and gold, to be preferred. Though mosaic was perhaps one of the means of preserving art and of introducing it into Italy, yet it should only be used in pavements, or to preserve the works of great masters. The anti-pagan zeal of the early Christians is well known. They used to put ropes round the necks of Apollos and Venuses to try them publicly, like criminals, find them guilty, and pound them to dust. But human nature is always the same. A thousand years afterwards a similar scene was acted in Scotland by John Knox and the reformers, nor had England escaped the fury of iconoclasm. Eusebius[2] informs us that in the empire whole towns rose and destroyed the temples in which they had just worshipped. The air echoed with the noise of hammers, the crashing of pediments, the breaking of pillars, and the shouts of a maddened and frenzied populace. The finest works of Phidias, Scopas, Polycletus, and Praxiteles, and all that was left of Polygnotus, Apelles, Zeuxis, or Euphranor, were demolished or burned, like wretches who had infected religion, and their ashes were danced on with fanatical exultation. So great indeed had been the destruction, that when Arcadius and Honorius issued a fresh edict to go on destroying, they added, as well they might, "Si qua etiam nunc in templis fanisque consistent, "If any pictures or statues are still left." During this frenzy was introduced into art, *painting without nature*, and after producing a race of monsters down to Golzius and Spranger, there began the cant of "nature putting an artist out." What Zeuxis did not dare to do, what Apelles never thought of, what Phidias never permitted to be mentioned in his school, a parcel of painters brought into practice by the very mysticism of their impossible theories. Man was corrupt, being born in sin and vicious in practice; to take him as a model therefore when painting holy subjects, was to act under the influence of Satan. Man was banished, and so was woman, and nature in every thing; till at last all painters painted in one way, and in came *manner* into the great art of nature, and like a "leperous distillment" stained her garment and poisoned her beauty. Yet the traditional maxims of the ancient fathers, on beauty and art, give one a very good idea of what were the maxims of the finer Pagan periods. "Art is nothing but an imitation of nature," says St. Athanasius, (*Orat. contr. Gent.* c. xviii. p. 18.) "Ancient artists sought to surpass each other by faithful imitation," (Arnob. *Advers. Gent.* lib. vi. fol. 68) "Nature is the archetype, art the image; every image has a model, and painters imitate what they see," (Theodoret.) "Imitation is the merit of painting; be not seduced by an illusion," (St. Clement.) "When begging the people not to be seduced by pictures and statues as if they were gods, tell them that pictures and statues are imitations of nature, and therefore cannot be gods." These maxims of the fourth century had clearly descended from a nobler era. Besides the treatises of Apelles, Euphranor, and Pamphilus, were all in existence, and were read by the educated and accomplished; and we see how skilfully the fathers of the church tried to save fine works from destruction, by assuring the people that they were *mere imitations of life*, for such was the principle of artists. Are not these quotations then collateral evidences of the practice of the Greeks, if we had known nothing of the girls of Crotona sitting to Zeuxis?

Influence of Christianity on the arts.

But Christianity was at first the ruin of art, by making purity of heart every thing, and physical ugliness, or deformity, nothing; by teaching that as all beautiful works of art were remnants of idolatry, they ought to be destroyed; and by inculcating that mankind being corrupt and born in sin, no Christian painter ought to look at the naked figure whilst he was painting it. Add to these prejudices, the predilection of eastern notions for gold and silver, the preference of eastern dresses to the simplicity of Greek clothing, the controversies which took place as to whether our Saviour was ugly or handsome, and the vehemence with which Pagans and Christians both entered into them; and no one can wonder at the state into which painting declined.

Representations of Christ.

The division of opinion about the person of Christ, and the dread of the early Fathers to expose the cross to Pagans, who, familiar with golden-locked Apollos and perfumed Venuses, could not comprehend that suffering and majestic pains were founded upon a higher philosophy, so embarrassed the painters, that to avoid collision they painted Christ *as an allegory* thus lingering with their Greek feelings about the form of beauty and of grace. It must be interesting to all readers thus to trace the progress of feeling relating to the head of Christ.[3] In the fourth, fifth, and sixth centuries, beauty and youth still predominated; and he is painted youthful and handsome, crushing the lion under his feet, or as a young shepherd with his flock. With allegory the beauty of our Saviour ended, whilst the Fathers of the church, like the priests of Egypt, interfered, and issued an edict ordering him to be represented in agony on the cross. But here the order was evaded. The Greeks still struggled for the beautiful, and as if it were the never-dying principle of their souls, painted our blessed Saviour dying upon the cross, but smiling with triumphant glory as if re-

[1] Spartian, *In Vita Pisc. Nig.* cap. 6.

[2] Montesq. *Décadence des Romains*, 133.

[3] St. Augustin declares that in his time no faces of Christ or the Virgin were known, and that no pictures were painted of them before the council of Ephesus; yet there are seven reported originals, four of which are by St. Luke's own hand, now in Rome.

Painting. joicing in his sacrifice. In whatever the Greeks were compelled to do, beauty seemed still to be the basis of their art. By degrees, however, the poor descendants of Apelles and Polygnotus finding no employment except on the conditions prescribed, the person of Christ became gradually degraded in art; and at the separation of the Latin church, to paint him ugly, bloody and agonized, was the settled principle of representation, and has more or less influenced his representation ever since. There seems to be some doubt as to the extent of the devastation committed by the Goths. Alaric staid but three days in Rome, and Attila had himself painted in one of his Milan palaces seated on a throne, and receiving the homage of a Roman emperor.[1] Theodoric seems to have had a very good feeling for art. He laments, in a letter to Symmachus, the ruins of works of genius, begs their preservation, and concludes with observing that Rome has still a *population* of statues with herds of bronze horses. The expulsion of the Goths and the invasion of the Lombards, again afflicted the art; but it had found its way into France, and the churches of Paris, Tours, Bordeaux and Clermont, were ornamented by native painters.

Epoch of Charlemagne. Though the popes had begun to adorn the churches, and art in the earliest times had been kept alive with considerable talent in the catacombs in Rome; though Europe had been astonished by the splendour of the ecclesiastical patronage of painters; yet the next great epoch after Constantine originates in the efforts of the illustrious Charlemagne. He formed the plan of renovating art, science and literature; and he would have accomplished his object, if the genius of the age had been worthy of the emperor. The ancient practice of painting churches, kept alive by previous popes, he confirmed by a law; and agents every year visited the provinces to see that the law was observed. If a royal church was to be painted, the bishops and abbots were responsible. If, in the midst of a campaign, an order was issued for a church, one to paint the walls was included; and no church was considered as finished till that was done, the object of the emperor being to obliterate the remembrance of the splendid altars of the Pagans, by still more magnificent Christian ornaments. "Repair your church," says the archbishop of Treves; "you know the decision of the emperor."

Two monkish painters of the time are celebrated; and France and Britain began even at this early period, to take an interest in the arts. Biscop, abbot of Weremouth, had brought pictures from Italy. Charlemagne had invited king Offra to protect painting, with but little effect; yet though the walls of English churches were whitewashed, the English began to adorn the ceilings and the windows, and hung tapestry upon the walls.[2]

In Spain, the Arabians had introduced their art, such as it could be, under the prohibition of Mahommed; and miniatures or manuscripts were so eagerly bought all over Europe, that the artists in France, Germany and Italy, devoted themselves to this production; though here again it was acknowledged by all, that they were beaten by the Greeks. In spite of all this, the art continued to decay; and at the second Council of Nice the members gave evidence of the state to which monks and bishops had reduced it. "How can painters be blamed?" say they; "the painter *invents nothing.* Invention and composition belong to the Fathers;[3] the art alone is the painters'." Inadvertently, too, the emperor injured the art by altering the dress of his cavalry and foot. The women as usual followed the example, and having relinquished the pure taste of the Greeks, dress has in consequence become an annual novelty and change. The Paladin and his horse were covered with iron and mail; angles and straight lines predominated; the naked form was more than ever concealed, and the artist deprived of his materials.

Painting. The middle ages. Though the art suffered at the death of Charlemagne, yet it was kept alive by monks and by bishops. At Rome, at Palermo, and at Milan, religious painters preserved it from decay; they sprung up all over Europe, and even St. Dunstan, Archbishop of Canterbury, is spoken of as a skilful painter and maker of instruments.

It is curious, after all that has been written about oil painting, and the discovery made by John Van Eyk, to find a writer of this period called Eraclius, in a treatise on painting, speaking of oil painting: "De omnibus coloribus cum oleo distemperatis." Another monk wrote a treatise, in which he says, "he will tell the world how the Greeks mixed their colours." Now, as according to Suidas, the writings of Apelles and Euphranor, were in existence in the tenth century, and these people lived before that time, there is reason to believe that they were aware of oil painting having been practised in ancient Greece, and that subsequent discoveries were but different revivals.

Whilst the art feebly struggled on in the west, the court of Constantine Porphyrogenitus was the rendezvous of artists, and in 997 St. Mark was built at Venice by Greeks. In contrasting Greek with Roman art at this time, the Greek is still superior. The Greek composition did not want dignity, whilst in the Roman, all sound principle seemed dead. The most ignorant Greeks shewed taste in their draperies, and their heads have character, and in the arrangement of hair, they remind one of the Panathenaic procession; whilst the Romans, with their large heads and long limbs, evince a gross ignorance of beauty.

In the tenth century, tapestry for a time superseded painting; though in Germany, France, Italy and England, many painters flourished. In England, historical commemorations were in fashion, and the Duchess of Northumberland adorned Ely Cathedral with a series of pictures illustrating the deeds of her distinguished lord.[4] When William the Conqueror came, he introduced a new style of architecture; but both at York and Canterbury, paintings then adorned the walls. In 1013, a head of Christ was executed in mosaic, and is still considered as the wonder of the middle ages.

Symptoms of revival. After so many vicissitudes of fortune, painting now began to shew symptoms of revival. Frescos had been executed in Rome in 498, and in 795; and there was a head of Christ painted in St. John Lateran, and still to be there seen, which gave evidence of great feeling. But the grand impulse was given in the year 1066, when St. Didier sent for Greek artists to adorn Monte Casino at Subiaco. The example was followed. Pisa, Venice, Amalfi, Genoa, and Milan, all municipal corporations rivalled each other; and when Pisa sent to Greece to collect as many splendid remains of art as could be obtained to adorn the dome of the city, Buschetto, a celebrated Greek architect, was engaged to superintend their embarcation, to accompany them during the voyage, and to land them safely for the purchasers. Buschetto was received with so much enthusiasm, that he founded a school of sculpture, which existed for two hundred years; and ultimately out of this very Greek school, came the great artist Nicolo Pisano, the head of the Italico-Pisan school. From this moment art, after having sunk to the lowest barbarism, went on improving till the taking of Constantinople by Mahommed II., an event which scattered the Greeks collected at that court all over Europe. Hundreds went to Italy as painters, sculptors, chasers, and mosaic painters; and by their struggles for existence, inoculated Italian artists with some remnant of their taste for beauty, decayed as it was. Cimabue was their pupil, and Giotto was his. The Catholic church wanted artists, and genius again began to shew itself. One man of genius appeared after another, till Michel Angelo,

[1] Suidas. [2] William of Malmsbury. [3] Concil. Nic. ii. act. vi. tom. iv. ed. 1714. [4] Strutt.

Painting. Leonardo, Raffaelle, Titian, and Corregio, were the glorious results. And though it cannot be denied that the high aspirations of Christianity, by placing every thing human on its proper level on earth, in comparison with eternal happiness, had justly prostrated the splendid beauty of Pagan art, by exposing its idolatrous tendencies; though the sufferings, and the agonies of its founder and its martyrs had revived its pathos with higher objects than mere beauty of form or face, and saved painting and sculpture from extinction; yet it must be acknowledged, that the beauty of Christian art has never rivalled the indisputable perfection of the Pagans. To their enthusiastic overestimate of the religious value of physical, as emblematic of moral beauty, is their perfection attributable; but if it can only be revived by some similar delusion, the result will in our opinion more than atone for any thing that seems doubtful or questionable in the principle.

The most eminent pictures of the middle ages, setting aside the cemeteries or catacombs, which cannot legitimately be referred to the middle ages, but to the earliest ages of Christianity, are to be found in Rome. The greatest works of the middle ages are the series of Popes, begun in the fifth century, and continued down to the present time. The next, which was executed in the year 1011, is the painting of the church of St. Urbano, where some of the Acts of the Apostles are represented on the walls. Though the mosaics of St. Mark's, executed by Greeks, were earlier, and kept art alive, yet, according to Lanzi, nothing in reality appeared which gave symptoms of the approach of any thing extraordinary, till about the thirteenth century; and this revolution of style was entirely owing to sculpture.

Italian schools of painting—The Tuscan.

The glory of this art belongs partly to the Tuscans, the legitimate descendants of the ancient Etruscans, but most especially to the Pisans, who first had the courage to burst the yoke which Greek art in its fallen state had imposed upon them, and to go at once to the antique; and this glory belongs to Nicolo Pisano, a pupil of the school originally founded by the Greek Buschetto. There were in Pisa several ancient sarcophagi, but especially one, containing the body of Beatrice, mother of the Countess Matilda, with a bas-relief in good style, which served as the model of Nicolo; on this he formed his style, in which there is something of the antique, especially in his heads and draperies. Many artists who had not done so before, immediately devoted themselves to sculpture; and Nicolo Pisano must be considered as the first Italian, who opened the eyes of his contemporaries to the true principle of using the antique, that is, keeping nature in view at the moment of practice. In 1231 he cut an urn in Bologna, whence he was called "Nicolo of the urn;" and he produced two stories of the last judgment at Orvieto, and another work at Pisa, which convinced the world that he was born to found an epoch. He executed other great works, and was really the head of the illustrious school which produced Orcagna, Donatelo, and the famous Lorenzo Ghiberti, who made the beautiful bronze doors of which Michel Angelo said, that they were worthy to be the gates of paradise.

Pisano.

Many other eminent men came from his school. All Italy was more or less affected by Pisano's genius; and though a sculptor, his effect on design was so great, that he must be considered as having had a material influence on painting. Painting remained behind sculpture, and even mosaic; and Vasari exaggerates the effect of Cimabue's appearance in the year 1240; for Lanzi proves that there were Pisan painters of talent before that period, and that the early art does not in the first instance owe so much to the Florentines as Vasari has asserted. At Assisi there is a crucifixion by Guinta Pisano, who, according to an inscription, learned his art from the Greeks in 1210. This was before Cimabue; but Lanzi says that the work is not inferior to Cimabue, and in drapery, colour, light, and shadow, composition and expression, very like the contemporary Greeks. Guinta disappeared and died, nobody knows where or how. Guido di Sienna was another name of this early period. In the Louvre there were some exquisite heads of angels with gilt glories, full of beauty and expression, executed by this artist. Then followed Margaritone, who painted on canvass covered with size and plaster for a ground; which the Egyptians, Greeks, and Romans, had done long before his time.

During the time that the neighbouring cities had founded a new style, Florence had no painters; but when the authorities called in some Greeks in 1250, it is asserted that there was a painter called Bartolomeo. Vasari wishes of course to infer that Cimabue was the first Italian painter who gave the impulse; but Lanzi proves the contrary. Although there is no city we owe so much to as Florence, yet the Florentines ought not to be allowed to deprive their old enemies of the honour of having produced earlier painters, besides Pisano.

Cimabue.

Cimabue, who was both architect and painter, was honourably descended. That he might have been the scholar of Guinta is probable, because the Italians knew more than the Greeks of that time; but there is every reason to believe that he learnt of those Greeks who had been called to Florence, and whom, according to Vasari, he stood whole days, when a boy, watching as they painted in Santa Maria Novella. From this moment indeed may be dated the excitement which impelled him to become a painter. At Assisi his genius seems to have been put forth with most power. Lanzi concludes the notice of him by saying, that Cimabue was the Michel Angelo, and Giotto the Raffaelle of his age. In the Louvre there were one or two large examples of Virgins, staring and Gothic, and which the French, still more Gothic, were absolutely repainting.[1] Vigorous in his colour, and colossal but ill-proportioned in his figures, Cimabue first gave indications of attempting something new in painting; indeed, his watching the Greeks all day is so like an infatuated youth, that it bears truth on the face of it. Florence was often in commotion when his works appeared; and although he was not actually the oldest painter, he was the first of that series which ended in Raffaelle. His style was meagre, his drapery sharp, and his colour a species of illumination; but though he had no light and shadow or perspective, he was a great man for his time; and in some of his heads there are both character and expression.

Giotto.

Men of genius assist to call forth men of genius. In the neighbourhood of Florence, Cimabue accidentally found a youth tending sheep, and trying to draw one upon a slate. After some conversation with the boy, finding the youth ambitious to become an artist, he consulted his father, took him immediately under his own tuition, and advanced him rapidly. Cimabue was amply repaid for his generous conduct, as the innocent youth was Giotto, afterwards one of the great men of the time. No man can judge of Giotto's genius in England, because fragments of single heads or bits of altar pieces, are no fair criteria of a genius like his. His series of pictures in the Campo Santo are admirable, if allowance be made for the taste and simplicity of the age; but there are many actions and positions of Giotto, as fine as can be conceived, and which other artists by aggrandising in form, have rendered models of imitation. He was the friend of Dante, and painted the portrait of the great poet. He seems to have been a facetious and amiable man as well as a genius, and was indisputably the greatest painter till Massacio. He

[1] The writer of this article, who saw a Frenchman solidly repainting a large picture of Cimabue in the private rooms of the Louvre, where he was admitted by Denon, asked the Frenchman who it was by: "Monsieur," said he, "je ne suis pas peintre, je suis restaurateur."

went about Italy scattering seeds every where, and when the Papal See was moved to Avignon, he went with the court. Giotto was the greatest of the Florentine school. He was the father of painting, as Boccaeeio was the father of literature. He was sought for at Ravenna, and at all the great towns of Italy, and was patronised by all the first families. He was an object of study and admiration, until the time of Raffaelle, and that of the Caraccis, and is so even at the present time. There are in Giotto instances of pathos and expression, which would do honour to any period. Thus the greater part of the merit belongs to the Florentines, but not the whole. Giotto died in 1336, when painters had increased immensely. In 1290, the first soeiety of artists in Venice was established, under the protection of St. Luke. They were not academies, but assoeiations of artists, composed of engravers, painters, sculptors, and orefiei. Their object was to advanee design in all arts; and had they always eontinued to act on this honest and simple principle, we should not now have had to lament in Europe a race who are synonymous with every thing weak, mannered, and absurd in art.

Buffalmaco. The next distinguished artist was Buffalmaeo. Although totally independent of Giotto, he was also intimate with Boccaecio. He was very eapricious, and worked only when he liked, yet he was inferior to no one. He painted the Crucifixion, Resurrection, Ascension, and Creation of the World in the Campo Santo; in fact, the Campo Santo seems to have been a receptacle for all the distinguished geniuses as they appeared in that age. In it there are things as fine in conception as were ever imagined; and the foundation of some of Raffaelle's best compositions in the Vatican may be there found. Vasari's life of Buffalmaco is exceedingly entertaining, as indeed all his lives are.

The Orcagnas. The two Oreagnas, Andrea and Bernardo, were the next artists of this early sehool. Andrea, painted the Judgment and the Inferno, in the Campo Santo. He was full of invention, but not equal to the Giotto sehool, though he first gave evidence of perspective. Lanzi thinks that the art did not advanee so quickly after Giotto's death as it ought to have done. Taddeo Gaddi, his best pupil, was to him what Julio Romano was to Raffaelle. Vasari, who saw his pictures in good condition, says, that he excelled his master in fleshiness and eolour. Agnolo Gaddi the son of Taddeo, was a humble imitator of Giotto and his father, and had as his pupil Ceronino Cininni, whose treatise on the meehanical preparations of the art is very valuable. Fortunate would it have been had the treatises of Apelles and Euphranor also reached us.

Florentine school. Pisa now began to decline, and the Florentines took possession of that city in 1406. Hated and detested by their conquerors, the spirit of the citizens sunk into the greatest depression; the artists left the eity, and the school entirely decayed. The Florentines now rose in the aseendant. The Mediei began to appear. Cosimo, the father of his country and the protector of genius, gave fresh energy to art, science, and public affairs. Lorenzo followed, and their house became the refuge and resort of all who were eelebrated in painting, poetry, sculpture, arehiteeture, and philosophy. Masaccio, the two Piselli, the two Lippi, Binozzo, Sandro, and Ghirlandaio, reeeived from the Medici protection and employment. The pictures of the time have perpetual portraits of the Mediei. The citizens became animated with the same spirit; freseoes covered the churches, and smaller works filled the houses. Up sprung, too, that host of painters, marble-cutters, bronze-casters, and chasers, by which the prineiples of design passed from Pisa to Florence; and out blazed before the world Donatello, Brunellesehi, Ghiberti. The most exquisite produetions of seulpture, marble, and bronze followed. The youth became inoculated; sound design became the first neeessity of manufacture; and though the finest works of Italy at this or any period cannot be compared to the finest works of Greece, yet a good style of design was established, but unequal to those refined forms of beauty, so palpable in the merest fragments of the works of the school of Phidias, which have all the look of life without any of its vulgarities, all the essential details, without a single superfluous one. This cannot be said of the naked figures of the period in question, or of any period of Italian art, not even of the art of Michel Angelo and Raffaelle. There was a want which Greek forms only supplied; there was an absenee of refinement, and a want of something which the Greeks possessed. Miehel Angelo and Raffaelle were educated without system. There was no school in Italy like the schools of Sicyon and Rhodes, Athens, and Corinth, where all the hidden secrets of perfeet form were taught, that is, the seeret of beauty. Miehel Angelo and Raffaelle owed their greatness to their own genius; and their art died with them. There has been nothing in the world like the art of Phidias, except the poetry of Shakespeare. The intellectual powers and perceptive senses of the Greeks must have been several degrees more refined than those of all preceding or subsequent nations.

Massaccio. The followers of Giotto had advaneed the art from infancy in colour, eomposition, and expression; but in perspective, and light and shadow, they left it as they found it. Uccello had given symptoms of perspective, and Massolino da Panieale of light and shadow, until the appearanee of Masso di S. Giovanni, a youth so immersed in study, so utterly absorbed in his divine art, that he negleeted dress, health, food, sleep, and seemed only to be eonscious of life when he touched a pencil. For this entire neglect of the humanities and comforts of life, the Italians, whose satirieal turn is ever apparent, added *accio* to Masso, (*accio* affixed to any word exeiting assoeiations of dirt or ugliness,) so that Mass*accio* meant a dirty and negleetful man. Negleetful as he was, however, he was the immediate precursor of Raffaelle; and all the great subsequent painters studied him. Raffaelle borrowed from him Paul in Elymas, the Adam and the Eve in the Loggia, and other entire figures. Like Apollodorus, he opened the doors; and Raffaelle having passed through, never forgot his obligations. Ghiberti and Donatello formed his style; from Brunaleschi he learnt proportion; and though the finest antiques were not known in his time, he improved himself by studying such as were in existence. The airs of his heads are *Raffaellesque*, says Mengs; yet, would it not be more just to say, that Raffaelle's heads are *Massaciesque?* Raffaelle died the favourite of a eourt, loved, lamented, and in eompetence. Massaecio so exeited the envy of his inferiors, that it is suspected he was poisoned at the age of twenty-eight, before he had fairly taken his ground. Surely, then, when Massaecio is praised for what must have been his own, it is not quite fair to term his excellenee, that of a man who came after him, and perhaps owed it to him. His works are at S. Ambrogio, and del Carmine in Florenee, and St. Catherine in Rome. His heads are full of eharaeter, his drapery is beautifully eomposed, and his composition is unaffected, but his knowledge of the naked form is feeble and vulgar. Some of the heads of del Carmine are full of eharaeter like Holbein, with the same look of rigidity in expression; but he was a true genius, benefiting by his predeeessors, going beyond them, and enabling those who studied him to earry the art to the highest point it ever reached in Italy. Pietro Perrugino, Leonardo, Raffaelle, and Miehel Angelo, all studied and all were benefited by him. In the Palazzo Pitti there is a portrait of a young man who looks alive.

Ghirlandaio. After several names of great merit, we reaeh one who advanced towards the great era; we mean Domenicho Ghirlandaio, the master of Michel Angelo, a eireumstance whieh alone is a passport to immortality. Fuseli says, that he was the first Florentine who added truth to composition by truth of perspective. The abolition of gold fringes in drapery may

Painting. be dated from him; though his historical figures are little more than portraits well-selected. The last important name of the first epoch of Italian art was that of Luca Signorelli, who had glimpses of real grandeur. His dome at Orvieto, where he painted the Last Judgment, has bold fore-shortening, with absurdities of an earlier date mixed up in it; but Michel Angelo adopted many of his ideas, as well as Dante's; and certainly the absurd assertion that he "disdained to look abroad for foreign help,"[1] is successfully refuted by this fact.

One can see how gradually art sunk after its decay into Gothicism; how gradually it advanced again to nature and common sense, and from common sense to elevation. During this first period the approaches to ideal beauty, imperfect as it was in Italian art, were gradual, and would have been longer in coming had not the discovery of the Apollo, and other ancient works, opened the eyes of all the great men living, and a spring taken place from Perrugino, Ghirlandaio, and the Bellinis, which was soon visible in the works of Raffaelle and Michel Angelo. Leonardo seems not to have been smitten by the ancients to the same degree as the other two were. There is less obligation to any nation in him; and unquestionably few as are left of the effusions of his genius, they are more original than the Vatican or Sistine Chapel. What was there in the world to put us in mind of the Standard struggle or Last Supper of Da Vinci?

Oil painting. But before proceeding, it may be as well to allude to the question of oil painting. It was long a supposition that Van Eyk discovered it, and that it was not known before; whereas, it was used in England in 1230, long before the time of Van Eyk. Cennino Cennini wrote a treatise on the technical practice of the Italian painters; he was a pupil of Agnolo Gaddi, who was a pupil of Taddeo Gaddi, who was a pupil of Giotto, who was a pupil of Cimabue, who was a pupil of the Greeks. There can be no question that from the mixture of oil with punic wax[2] as a varnish, the use of oil was known to the ancient Greeks, and that it was carried on to the tenth century, when the monk Theophilus[3] wrote his treatise. He positively describes how to mix the colour with oil instead of water, and how to boil the oil; and then we can prove its existence by actual documents in the rolls of the Exchequer in England (1239), and by the 23d of Henry III., wherein the king issues an order to "our treasurer Odo the goldsmith and his son, to be paid 117 shillings for *oil, varnish,* and *colors* bought, and for pictures made in the chamber of our Queen at Westminster,"[4] nearly two hundred years before Van Eyk. There can be no doubt that oil painting has never been unknown, even to the Egyptians; it has been forgotten and revived, but none of the periods of revivals are entitled to the honour of discovery. "Chaque nation a ses avantages, et ses désavantages," said a Frenchman to us, whilst shrugging his shoulders as a spout of water from a roof drenched him to the skin in Paris; and "Ogni nazione ha le sue virtù, ha i suoi vizi," says Lanzi. Every nation which confesses its vices, is sure to have justice done to its virtues. There is no Italian school, however good, which has not its errors, and none which has not its excellencies as well as its mistakes.

Florence was distinguished for fresco more than for oil painting. The Florentine style of design, in its best days, was always peculiar; the figures were long in proportion, their feet were small, and so were their knees; there was always a look, in Florentine design, as if the muscles of the body were suffering from a temporary knotted cramp; they were, in design, too circular, too elliptical, or too angular, and never seemed to have hit the exact medium between all three, like Phidias. Their colour was not rich, like the Venetians; their draperies clung too closely to the limb as if they were wet; they made an ostentatious display of the limb underneath; in fact their system degenerated into manner, and beauty seems not to have been a primary object in the Florentine school, any more than in that of their ancestors the Etruscans. At Fountainbleau, though the designs of Primaticcio were full of talent, yet they gave a very good idea of the excess of the Florentine manner.[5] The two great luminaries of Florence were Da Vinci and Michel Angelo. Da Vinci was less of a mannerist than the other great man. He was, in fact, the link between the meagreness of the first period of design, and the vulgar swing of the second.

Leonardo da Vinci. Leonardo was born in 1452. He was a natural son, and had all the eccentricity, sloth and fire, weakness and energy, idleness and diligence of that class. A poet, a musician, a mathematician, an hydraulist, a mechanic, a modeller, and a painter; he excelled in all. Keen, eager, minute, searching and indefatigable, handsome in face, beautiful in person, tall in figure, athletic and skilled in manly exercises, a graceful dancer, a splendid horseman, and an harmonious singer; he equally delighted the people, infatuated the women, and bewitched the sovereign. And yet with all this vast power, the gift of his Creator, he was so deficient in concentration of mind, that he seemed to have no power of collecting its rays sufficiently long to make discoveries in any thing. He was the scholar of Verocchio, by whom he was infected with a lazy love of design in preference to the vigorous energy of using the brush. He passionately loved geometry, horses, and soldiers; and in his horses he never left nature like Raffaelle, Julio Romano, or Michel Angelo, but gave them their natural characteristics of fleshy nostrils and projecting eyes.

His two greatest works are his Last Supper, and his Battle of the Standard. The beautiful humility of Christ, the tender amiability of St. John, the powerful expressions of all the apostles waving to and fro in their attitudes, as if disturbed in their feelings, by the remark of Christ, that "one of them should betray him," prove the extent of his genius, and the depth of his perceptions. But even here, the bane of his existence, that disposition to experiment, has ruined the work, more from the consequences of his own preparations, than either time or damp. Such men are never regarded as steady lights by posterity; painting was only a portion of his occupations, and not the end of his life. One quarter of the lives of such men is spent in experiments; another quarter in putting them in practice; a third in lamenting their failure; and the last amidst the bitterest remorse, devoting themselves to their real pursuit, to satisfy the cravings of conscience and the reproach of the world. What has Leonardo left us in all his various pursuits to compensate us for the loss which accrued to painting? Geometry was as much a caprice of his extraordinary mind, as any other science. What has he left us in poetry, which poets could look up to? What in mechanics, that Watt could have founded on? What in music, that would have benefitted Mozart? What in hydraulics, that would improve our shares in canals? The genius that composed such works as the Standard and Last Supper, need not to have shrunk from competition with Michel Angelo, young as he was. There is no doubt the world is always delighted to pull down an established artist by pushing up a younger rival in his face; but if you become irritable, and desert your

[1] Reynold's note.

[2] Pliny, lib. xxxv. Cera punica cum oleo liquefacta.

[3] Lib. i. c. 18. Accipe semen lini et exsicca illud in sartagine super ignem sine aqua, &c. Again, "cum *hoc oleo* tere minium, *super lapidem;*" and again, "accipe colores quos impone volvens, *texens eos* diligenter cum *oleo lini.*" *(De omni Scientia Artis Pingendi.)*

[4] Rot. Claus. 23d Henry III. Walpole's *Works*, vol. iii. p. 16.

[5] In 1814, the writer saw the remains. There was a naked youth over one of the gateways, which had all the peculiarities of this school.

Painting. country from disgust, men only laugh; whereas the sound principle is, Laugh at the world, stay in your country, and work harder than ever.

The fact is, that such men as Leonardo are great geniuses, but not the greatest. The evidence of superior genius is the power of intellectual concentration. Such powers had Newton, Milton, Bacon, Locke, Watt, Michel Angelo, Napoleon, Raffaelle, Titian, Rubens, Vandyke, and our own Reynolds. Such men only are examples, and not beacons; such men only are blessings to their species. As a specimen of his extraordinary caprice of character, his want of perseverance, and his notions of the most elaborate finish were at least equal; he took four years in painting one face, and then said it was not done. His children are exquisite; but his women have an air of modesty to conceal meritriciousness, and his oil-works are far from models of excellence, the over-wrought finish being hard. There is always in his expressions an air as if they were set in enamel, and could not relax. The picture, in our national gallery, of Christ and the Doctors, is a celebrated work; but why should Christ, who disputed with the doctors at twelve years of age, be larger in person and head than the doctors who are sixty? And why should Christ be like a woman in men's clothes, and look out of the picture, and talk with his fingers to the spectators, instead of being, as he was, a fine boy of twelve years old, handsome, intellectual and angelic? We should like to have heard Leonardo's reasons, if he had any, for such an apparent absurdity.

In design, and tempera or fresco-painting, Da Vinci was great; but in oil pictures he is false in taste, petty in execution, and unskilful in backgrounds. By his depth of light and shade, and also of colour, which gave an impulse to all Italian art, he had a sense of beauty which greater steadiness might have brought out to perfection. But when a man flies off from painting to make a lion, which will walk by machinery, to meet the king of France who approached Milan, to stand upon his hind legs without human help, to open his own belly, and show the king of France his arms inside it, what could be expected from his talents, great as they were? Nowhere does his character show itself more conspicuously than in his treatise on painting; in fact it is not a treatise, but a collection of separate disjointed thoughts, like the recipes of a cookery book. It is very easy to put down your thoughts as they occur without arrangement; but the difficulty is, to collect them for the illustration of a principle like Fuseli or Reynolds. Every man can put down separate thoughts, but every man has not the power so to arrange them as to throw light upon an art. Leonardo dissected and drew finely; but there was a meagre common-model style in his figures, a want of perfect construction, as if men had never worn clothes. On the whole, this illustrious man cannot be referred to as the head of an epoch. He was a component part of it, but not like Michel Angelo or Raffaelle the great engineer. What he did in painting made one lament that he had not done more. "An artist," says Reynolds in his letter to Barry, "should bring his mind to bear on painting, from the moment he rises till he goes to bed; and if his mind be calm and undisturbed by other objects, he will find it quite enough to fill up life, if it was longer than it is."

Michel Angelo. No man could be more opposite to Leonardo, than his great successor Michel Angelo, patient, laborious, virtuous and indefatigable, painter, architect and sculptor; he left a work in each art that advanced the rank of his country. To turn to such a character, is a relief and a blessing. In him the aspiring youth contemplates the result of conduct totally the reverse of that we have been considering. Solitary, and highly gifted, despising the subterfuges of society, he lived alone; and in addition to his genius he was a great moral being. Brought up by the liberality of Lorenzo dè Medici, admitted freely at his table with the illustrious men of the day, Michel Angelo had every advantage in early education. He came, too, when he was wanted; when ancient literature and ancient art were breaking through the obscurity which had overwhelmed them, and the discovery of printing was scattering their beauties throughout Europe. Men's minds were roused up with wonder and delight at every fresh discovery. Painting, architecture, poetry, and science were hailed with a gusto which nothing can account for but the misery of the ages that had passed.

Michel Angelo, after his day's study in the gardens which Lorenzo had opened for the youth of Florence, retired to the coins, cameos, and fragments of the palace. With his acuteness, energy, and perception, it is not wonderful that he soon perceived the inferiority of the forms of his master, in comparison with the full beauty of the form, the result of perfect construction in the antique. He corrected with his boyish hand the narrow meagreness of Ghirlandio; and announced, thus early, that self-will and vigorous decision, which enabled him subsequently to accomplish whatever he undertook. Here was the germ of that mighty power which placed the Pantheon in the air, as he predicted and realized in the dome of St. Peter's. Here was the embryo fearlessness, that brought him through the vast ceiling of the Sistine Chapel in fresco, though when he began it, he had never painted in fresco before. Michel Angelo was one of those rare beings who are wanted when they come, and have opportunities put in their way adequate to develope the powers with which they are gifted. Julius II. was as wonderful a man as Michel Angelo; and they mutually inspired each other. What Julius willed, Michel Angelo was as ready to perform; and what the inspirations of Michel Angelo's genius suggested, the vigorous pope, whose fine old venerable head a helmet would have suited better than a tiara, had comprehension to value. They were both fierce, both self-willed, both proud and haughty, both independent and ungovernable. If Julius wished what Michel Angelo was in no humour to do, he would not do it; and if Michel Angelo wanted to execute, on sound principles of art, what the aged pontiff did not comprehend, he would do it, in spite of denunciations of banishment, or threats of displeasure. They were made for each other, they understood each other, and they were attached to each other; they quarrelled, became friends, and quarrelled again. "When will the ceiling be finished?" said Julius, as he trod on the scaffolding with a stamp that made the boards tremble, after climbing to the top, where the great artist lay on his back on a mattress, hard at work, painting with vigour. "When I can," said Michel Angelo, irritated at the interruption. "When thou canst," thundered out the pope; "Art thou minded to be hanged?"

This was the man for Michel Angelo. Conscious of his age, conscious that death followed him wherever he went, he began, proceeded with, and finished all he undertook, as if he had not an hour to live. By his perpetual watching, he hurried Michel Angelo through the ceiling of the chapel in twenty months, a time by no means equal to that which ought to have been devoted to it. The hurry is visible in the fierce, rapid execution; and that which was entirely owing to the impetuosity of his old patron, has been attributed as a merit and a principle to the great painter. Such is the infatuation of praise when a man is really great. Of this astonishing work, it seems that enough can never be said; though language has been exhausted to do it justice. Fuseli was the first who cleared up the mystery of the composition, in a style that places the commentator on a level with the inventor. "It exhibits," he says, "the origin, the progress, and the final dispensation of theocracy." But Fuseli's character of Michel Angelo is overdone. It is an effort to express the deepest feelings in the strongest language; and in all such efforts the language invariably becomes inflated and turgid.

In comparing this illustrious sovereign of modern design with Phidias, or the Greeks generally in the naked figure, he must unquestionably yield to them the palm. Michel Angelo often perplexed his limbs with useless anatomy; it must not be denied, and cannot be refuted, that he did not always clear the accidental from the superfluous. If the principle be a sound one, namely, "that any two parts of a body bearing comparison must keep a consistency throughout, similar in essence and similar in development," then is Michel Angelo grossly inconsistent; because if the spine of the ilium in front be covered fully by the muscles around it, so ought the spine of the scapula behind to be equally covered. If the former be, and the latter be not, then the figure is inharmonious and inconsistent, and what Phidias would never have tolerated. Now the figure of Michel Angelo's Christ standing with a cross, has the spine of the scapula prominent and bony, and all the muscles shrinking from it, the characteristics of a thin man; whilst the spine of the ilium of the same figure in front, is entirely covered by the muscles around it, the marks of a muscular and fleshy man. What authority had Michel Angelo in nature or antiquity for such inconsistency? These are the excesses which bring dissection into contempt, and which induce anatomists to doubt whether the Greeks dissected or not, because they were never guilty of such absurdities, and because they had too much self-control to make that an end of art which was but a means of the perfection of art. And yet Vasari calls it "mirabilissima." This figure and the Lazarus in Piombo's, as well as several figures in the Last Judgment, are justifiable grounds for asserting he was not equal to the Greeks in the naked figure; though in the conception and arrangement of a vast whole to illustrate a grand principle, he approaches but does not surpass the Parthenon in its glories. In the form he must not be compared to the Greeks; gigantic as he is, he was decidedly inferior.

Michel Angelo's line is by no means "uniformly grand;" and his women may be "moulds of generation," but certainly not of love. His infants may "teem with the man," but they have nothing of the infant. His men may be a "race of giants," but they are brutal in expression, fierce in action, and distorted in position. It is useless in a rapid and general view of art to go over ground which has been so often gone over before; to talk about the prophets and sibyls, after three hundred years' enthusiasm, is worse than useless. Europe knows the awful grandeur of one or two of them, looking like beings to whom God has spoken, and who have never since ceased meditating on the awful voice.

The style of Michel Angelo has been called the style of the gods; but if majesty without pretension, humility without feebleness, power without exertion, and an awful presence without vulgar assumption, be the characteristics of a god, what figure of Michel Angelo's deserves that appellation? Is it in the bullying defiance of Moses? the twisted tortures of Jonah? the cramped agonies of the sleeping Adam? or the galvanized violence of the ornamental figures at the tombs? It must be admitted, that the *Pensoso-Duca* is majestic and silent; but this is an exception, not an habitual characteristic. "Michel Angelo's mind," says Reynolds, "was so original that he disdained to look abroad for foreign help." Disdained! Why there is not a prophet, a sibyl, or a naked figure in the whole chapel where the torso cannot be traced. And what are the works of both Michel Angelo and Raffaelle, but improved completions of all that their predecessors had done for a thousand years in barbarism and obscurity? Shakespeare's plots are all borrowed; Lady Macbeth is not his own; that hideous expression "know Macduff was from his mother's womb untimely ripped," is Hollingshed's. But what of that? It is the new thoughts he puts into them, which give him claim to the sympathy of the world. Phidias and Raffaelle have one great and decided beauty in their works; their figures, whether in action or expression, always look as the unconscious agents of an impulsion they cannot help. You are never drawn aside from what they are doing by any appearance in them, as if they wished to make you consider how very grand they were, or how very gracefully they were moving. They seem impelled by something they cannot controul; their heads, hands, feet, and bodies immediately put themselves into positions the best adapted to execute the intentions wanted; whereas *often* in Michel Angelo, and *always* in his imitators, there is a consciousness as it were in his arms and limbs, which destroys all idea, as if his figures were the unconscious agents of an impulsion they could not help, and which acted by means of the will on the muscular system.

It is an inherent principle of life never to disturb itself for grace, or for any other object either in action or repose, not immediately the natural consequence of the impulsion which moved the body. Style in design is a *result* and not a *cause*. Whatever object is represented in painting or sculpture, the intentions of God in its bodily formation should be ascertained; the means which God has bestowed on it to enable it to execute its only will or gratify its own instincts, should be investigated; and then the aberrations produced by time, accident or disease, or other causes, will be clearly known, so that he who takes upon himself to represent any object in painting, will be able to distinguish accident from essence, and shew the object in its essential properties of body as God first created it. The external form in that body will then be *essential*, and the result of its completion in art will be *style* in design. There are certain inherent principles of our common nature to which all bodies must yield, viz. that compression and extension must have different effects, and so must repose and action. If a great artist represents a figure and makes its parts the same in either case, he must be ignorant of nature or above its simplicity. No doubt, the conception of an idea may be so grand, the beauty of a character may be so angelic, the pathos of an expression may be so deep, that errors or inadequacy in the mode of representation may be overlooked or forgiven; but in order to bring the art to the perfection to which the Greeks brought it, there must be nothing to forgive or to overlook. An idea or conception being the nobler part of the art, we may, in our common conviction of human frailty, *overlook* any inadequacy in the means of imitation; but the very admission proves there must be something to be overlooked and something which, we have a notion, has not been adequately represented.

An art the modes of which to convey thoughts, being the imitation essentially of natural objects, ought surely to have the imitation perfect, because the imperfection of the means has always detracted from the impressions of the thought. Poets are not endured if their grammar is bad, or their language defective; and why should drawing, form, colour, or light, shadow, and surface, the grammar of art, be excused more than the poets'? Because the simplest imitation is at once recognised as the imitation of the prototype, why should facility of imitation be any excuse for defect? Ah, but its the *grand* style. Yes, the grand style of Europe for the last three hundred years; but was it the grand style of the Greeks? Certainly not; their grand style was nature elevated not violated, with none of her inherent bases of life altered a hair's point, none of her essential details omitted, and none of her essential principles overwhelmed by useless detail.

When you see an outline like iron, that is the grand style. When hands were twisted, heads distorted, one leg up, and the other so far removed from the body, that you may question if it will return, that is the *grand style*. All this absurdity originated with Michel Angelo; and though he is not answerable for the excesses of his admirers, there must be

Painting.

something erroneous if every imitator has led to such extravagance from Goltzius downwards. Michel Angelo was a tremendous genius, and his effect on the art was vital; but he did not like the Greeks suffer the unalterable principles of life to keep in check his anatomical knowledge. This was an error, because we can imagine no beings, and no world where malleable matter is not influenced by the common principles of the solar system, or where any creatures composed of bones, muscles, tendons, and skin, must not yield to the laws which God instituted for their government when he created them.

Thus Michel Angelo often overstepped the modesty of truth, and gave a swaggering air to his figures. Every figure of his looks as if he was insulted and preparing to return a blow. If they sleep they seem as if they would kick; if they move when they are awake, they seem as if all their muscles were cracking. We allude particularly to the naked figures; Jeremiah and the Duke are exceptions, but they are only exceptions. Fuseli observed that Michel Angelo was the *salt of art;* but it would have been more just to have called him the *pepper*, because very little indeed will do for a seasoning. In poetry of sentiment the Medici tombs would perhaps have competed with Phidias; for Michel Angelo being a painter as well as Phidias, he combined in his sculpture a knowledge of effect. In selection of subject and daring execution of hand, perhaps the Sistine Chapel might equal the great works of painting amongst the ancients; but in naked representations *it cannot be compared to it.* The Elgin marbles had not then enlightened the world. The due subordination of all science to nature had not then been so exquisitely seen; the due combination of life without meanness, and of abstraction without losing sight of life, were not so apparent in the great works of ancient art which were found before this period. Had Michel Angelo seen the Theseus and Ilyssus, Jupiter's breast and horse's head, he would have felt the difference between the muscular swing of a blacksmith, and a hero naturally born powerful, without his muscles being distorted by manual labour; and that a hero might be elevated and yet simple, fleshy without fatness, and muscular without being skinny. Michel Angelo has been called the Deity of design; but he was rather the Devil. One can imagine the consternation of Phidias and his pupils, if suddenly at Athens the galvanized figures of the tombs had been let down through the roof, whilst they were preparing the Olympian Jupiter, with his quiet, solemn, steady, thinking, peaceful, awful look.

Reynolds says he prepared the way for the sweeping outline of Rubens; but how many thousands has he ruined? What is the excellence of the Last Judgment? Is there any evidence of power in arranging a whole, like Rubens, Titian, or Tintoretto? Is there any application of any principle of our nature by the due combination of variety and repose? Is it not a mass of separate groups, vulgar in design, academic in action, and demoniac in expression? Is the Christ worthy of Goltzius? Surely it would have disgraced him, and then what devils! Are these the fallen angels of heaven? they are the legitimate offspring of hell. Are these the beings whose glory was obscured, not extinguished? whose majestic forms existed, though in ruin? whose beauty was only disturbed by passions, not destroyed? who were the same grand, heroic, terrific beings as ever, but scathed by lightning, singed by fire, dingy from darkness, lacerated by thunder, their splendour sparkling through the horrid obscurity, in which they meditated revenge? To give them mouths like wolves, ears like asses, noses like pug-dogs, and tails like monkeys, with feet cloven and misshapen, was not to represent a fallen angel, but a deformed monster. Though evil, they were beautiful.

"—— Their forms had not yet lost
All their original brightness."

"What matter where, if still I be the same?" says Satan. Could such a sentiment have ever been uttered by the wretch who is dragging a figure down to the bottomless pit, in a way delicacy forbids one even to think of, much more to write or to paint? Michel Angelo's demons would not only torture the damned, but feed upon their bodies.

It is clear, however, that there *was* a time when he was not so exaggerated. The holy Family, in sculpture, brought by Sir George Beaumont from Italy, is playful, natural, simple, and beautiful; it is in fact a divine work. Perhaps the violence of Julius in hurrying him through the Sistine Chapel, and the necessity of painting with tremendous exaggeration, on so large a space, got his hand into a fierce power that it never lost. Painting on grand ceilings is like talking in large theatres. He never entirely finished any thing; he left no grand pupils, like Raffaelle; he assisted the humble, but never instructed the gifted. The figure of Lazarus in our national picture, especially the hand and thumb that press the shoulder of the attendant on the left side, is certainly by him; and if it be compared to the timid painting of the Christ, the spectator will be convinced of it. In fine, Michel Angelo was a great genius; but let the students of Europe be assured that his style has been grossly overrated; let them banish his works from their eyes, and substitute the Theseus and Ilyssus, and the real grand natural style of Phidias will soon exclude the satanic Etruscan, and violent anatomical distortions of Michel Angelo. He may be and was a giant in art; but Raffaelle was an angel, and Phidias a god.

Bartolemeo

The next Florentine of power was the monk Bartolomeo. He studied under Rosselli, and Leonardo aroused and excited him; he was grand in colour, light and shadow, and execution, surface, and character. In the Louvre there were works worthy of any hand, any competitor, or any genius. He had the honour of advancing Raffaelle; he invented the long figure, and made the proper use of it; he never put drapery on it till he had drawn the naked figure first, so that the naked parts affected the forms of his folds; he had great depth, grandeur, and a certain wildness of air; he drew finely, and his tones were solemn and elevated. Wilkie speaks with the highest enthusiasm of his Assumption of the Virgin. It is impossible not to feel the deepest interest in Bartolomeo, and not to be astonished that he did not found a school, and head an epoch. Such things, however, are never done by the mere influence of talent; the character of the man is principally though not wholly the cause. He painted a S. Sebastiano, which was so beautiful, that it became a favourite of Italian ladies. He was ordered to adorn the great hall of council at Florence, as Da Vinci and Michel Angelo had done before; but as if a fatality attended that hall, he died without going further than the designs. This is curious. Da Vinci designed the Standard struggle; Michel Angelo the group of soldiers alarmed by the trumpet, and dressing themselves; and now Bartolomeo began his designs, and died in 1517, without completing them. Bartolomeo was a great artist. His method was first to draw the naked figure, then clothe it, then paint the whole picture in light and shade in oil, and then tone and colour, guided by the tremendous depth of his first impasto painting.

Andrea del Santo.

Andrea Del Santo is another name enthusiastically overrated by Vasari. He might be called Andrea senza errori; but what genius "senza errori," ever enchanted the world? Give us the vigour of Michel Angelo, with all his violence, the dash of Tintoretto with all his caprice, the colour of Titian with his want of drawing at first, the sweetness of Corregio with his namby-pamby men. the composition of Rubens with his flabby women, the expression of Raffaelle with his hardness of effect; but spare us from that poet, painter, musician, or moral character, who is so perfect that he must be admired without the gusto of finding fault; above all, spare us from the Grandisons of art. Andrea was one of those to whom talent is more applicable than genius; whatever excellence he attained, he would have never attained to that degree, but for the existence of his superiors. The greater part of the works attributed to him in England, are copies by his pupils which he retouched.

Decline of the Florentine school.

After these great men, it would be useless to detail the decay of the Florentine school; it yielded to the circumstances of the time, and the misfortunes of the Medici. The continual political squabbles turned men's minds from art as in ancient Greece; but the great want of course was the want of genius, which no efforts have since been able to rear. Though the style of the Florentine school was not so pure as that of the Roman, it led the way in a noble manner, and kept side by side with it; they benefitted each other. Leonardo gave an impulse to art; and though from the caprice of his character, he did not complete the impulse he had given, and was more the cause of greatness in others, than the man who established his own, yet the art is indebted to this highly-gifted man, who had an effect on Georgione, Bartolomeo, Raffaelle, and Michel Angelo himself; and gratitude is due to his genius. This great school was brought to utter ruin by what Lanzi calls the Cortoneschi, or pupils of Cortona, where art had degenerated into mechanism, and thoughtless, endless, and sprawling groups. The descendants of the Medici breed had more disposition than power to patronise, till Leopold reigned in 1765. The academy was renovated in 1785, and once more in 1804; but these renovations end in nothing. The great men were passed without these conventional distinctions; the little ones who came after, live only by their embellishment. Boys are educated to draw tolerably well, to colour with tolerable harmony, to invent tolerably insipidly, to become intolerable painters, accomplished academicians, to die, be buried, and decay; and thus leave room for another race as intolerably imbecile in art, as their illustrious performers before them. It is quite absurd to read in Lanzi, always at the end of the epochs of a school, "Decadenza dell' arte, e *fondazione dell' academia per avivvarla*;" "decay of art, and foundation of an academy, to give it life." But after a few galvanic twitches it stretches out its feeble legs, gasps with an expiring quickness, gives a trembling of its eyelids, which it opens once more, stares with a fixed look, sighs deeply, and drops its jaw for ever. Then come the vain efforts to restore circulation, then the delusive assurances that it is still living; then doctors and nurses dress up its helpless head with laurel, and put some abracadabra on its cold breast; but all won't do for it's gone and there is no hope. Such have been the results of the academies. Genius fled at their foundation, and left them useless bodies without soul, life, or circulation. The sovereigns of Europe will at last find out that no academies should go further than schools; and till they do, the end of art will be forgotten, in a vain contemptible struggle for its conventional distinctions.

Roman School.

The three leading lights of art as schools, are the Florentine, the Roman, and the Venetian. The Parman must in spite of all the beauty of Corregio, be considered as the beginning of corruption. The other schools, the Modenese, the Cremonese, the Ferarrese, Genoese, and the Piedmontese, are but different branches.

Raffaelle.

The glory of Italian art is Raffaelle. Had he been born in Greece, and qualified by a Greek education, he would have been as great in painting as Phidias was in sculpture; but the education of all the Italian artists was imperfect, and they seemed to be grounding themselves, (even Raffaelle himself,) on the meagre style of the early painters. The discovery of ancient statues in some degree opened their eyes, but they were not, like the ancients, gradually prepared for such perfection, nor was Raffaelle himself ever skilled in those perfect principles of beauty, as applied to the naked figure, which distinguished the Greeks. Wonderful, amiable, and gentle creature as he was, the reverse of Michel Angelo in every way, he proved himself decidedly the inferior man. In all his endless inventions, a single repetition of himself, even in the folds of a drapery, is not to be found; he was not like Titian, an exquisite colourist, but his colour is always agreeable, though not distinguished for light and shade; and his groups are never obtrusive, though not remarkable for aërial perspective. Every object keeps its place; though no face of his can compete with the beauty of the ancients, his women always enchant; his great power was character and expression, and telling a story by human passions and actions; in these he was unrivalled in modern art, and not surpassed by the ancients. His father being a painter, he was bred up in the art; and his master Perrugino, was a great man in his way, though somewhat of a Goth. In style, therefore, Raffaelle lost time with him; but could he have gone in early life to such a school as Sicyon, there is no knowing to what a pitch of perfection he might have carried the art. His latter excellence is entirely owing to his own sense, based on the antique; for most of what he learnt from Perrugino he had afterwards to unlearn. He entered the Vatican at twenty-five, and died at thirty-seven. What then must have been his diligence, his devotion, and his genius. In any history of painting, at this time of day, to talk of the subjects of the Vatican, or the Madonnas, so often copied, so often engraved, so often seen, so often praised, would be trespassing on the temper of the reader. His character, as well as that of his art, was the very converse of Michel Angelo. Michel Angelo envied his equals, was kind to his inferiors, and always insulting to his superiors; whilst Raffaelle was kind to all, and the idol of the society in which he moved. Michel Angelo associated with no men but admirers. The consequence was that his life was written by his flatterers Condivi and Vasari, a great portion, perhaps, delicately insinuated by himself; and, as might be expected, they have sacrificed Raffaelle to the Dagon of their idolatry. Vasari insinuated that Raffaelle was greatly indebted to Michel Angelo; and Reynolds following Vasari and Condivi, goes farther than either, asserting that Raffaelle owed his *existence* to Michel Angelo. Was there ever such gratuitous assumption? If it means any thing, it means that but for Michel Angelo, his genius would never have been developed. Is such an absurdity worthy of Reynold's understanding? Surely not, and in fact it can be made clear that Raffaelle did not owe his existence to Michel Angelo. If he owed any thing to that great artist, he owed the corruption of his own pure style. After the Capella Sistina was opened, Raffaelle, bit like every body else by its heavy, cumbrous, vulgar, broad, and circular design, immediately tried it; but it did not suit his beautiful nature any more than it would have suited the elliptical beauty of the heroic forms of Greece.

What does Reynolds mean when he says, that "Raffaelle had more taste and fancy, Michel Angelo more genius and imagination?" If genius be nothing more than the ordinary faculties of men carried to a greater pitch of intensity than ordinary men possess them, wherein had Michel Angelo more genius than Raffaelle? Their geniuses were both equal; but the road which each took for the exercise of his genius was different. Raffaelle excelled in expressing the passions; Michel Angelo in sublimity of character, independently of all passion and emotion. Though the materials of Raffaelle's art are generally borrowed, are they more so than Michel Angelo's? Is not Michel Angelo as much indebted to Luca Signorelli and the Campo Santo, for his choice of subjects in the Sistine, as Raffaelle is in the Vatican? This does not invalidate their genius; whilst their predecessors were the root, the stem, the leaves, and the bud, they were the full blown flower. Michel Angelo was a great genius, and so was Raffaelle; but each owed his genius to a power totally independent of the other. Their geniuses were equal, their temperaments different. Raffaelle was at the mercy of pleasure; Michel Angelo disdained it:

Raffaelle was made for society; Michel Angelo despised it. In Raffaelle's works there is a geniality of soul with which every man's and woman's heart beats in sympathy; whilst we have no sympathy with the characters of Michel Angelo who overwhelms our imaginations, but never touches our hearts. We are awed by his Sibyls, but we could never think of loving them; and his demons are surely unworthy of the fiery solitudes of hell. How could Ariosto say of him,

> "Michel, piu che mortel,
> Angel divino;"

and then herd up Raffaelle with Sebastian and inferior men; Michel Angelo was perhaps the more moral man of the two, but not the greater painter.

Vasari and Condivi would never have been allowed to publish their falsehoods, as Lanzi says, had Raffaelle been living; but where were Julio Romano, Luca Penni, and Polidoro, whom Raffaelle had raised from a mason's boy to a great painter? Where were they? where were his "dear pupils?" "Let no man," says Johnson, "look for influence beyond his grave." Vasari asserts that Michel Angelo, in flying to Florence, when he quarrelled with Pope Julius II., left the keys of the Sistine Chapel, which he was then painting, to Bramante, Raffaelle's uncle, who dishonourably let in Raffaelle; and that the latter, on seeing the grand design of the prophets, changed his whole style. This absurdity was current in Europe for two hundred and fifty years, till Lanzi, with his usual acuteness, opened the eyes of the world. Would any one believe, that when Michel Angelo fled to Florence, it was in 1506, years before Raffaelle ever entered Rome, and four or five before the chapel was ever begun or painted? It may be presumed that Raffaelle did not surreptitiously derive any advantage from works four years before they were conceived or painted; and we conceive that Bramante could not give Raffaelle the keys to open a door which was never locked, especially as Michel Angelo did not leave any keys, if ever he left them at all, till four years after the time Vasari dates as the period. The prophet Esaias which Vasari says shewed an alteration of style in consequence of the stolen views of works which were not in existence, was painted one or two years before Michel Angelo touched this very chapel. So much for Vasari's sacrifice of Raffaelle to the great Dagon of his idolatry; and so much for Reynold's absurd and unthinking assertion, that "but for Michel Angelo, Raffaelle would never have existed." Vasari's is a delightful book, and all his principles of art are sound, for they are the result of conversations with the greatest men; he was most intimate with Michel Angelo, and Titian, and all the great artists of the day, and constantly in their painting-rooms, at their tables, and in their society.

In the first years of Raffaelle, his feeling was so completely Perrugino's, that it was almost impossible to distinguish their works; though there is a difference in feeling, and that difference is in favour of the pupil. In the Louvre were three of his early works of cabinet size. The Annunciation was one of these; and more grace, innocence, or sweetness, were never put on canvass. Raffaelle's pencil seemed always to melt when he approached a woman or an angel. What an age of genius this was, and how nearly all the great men seemed to come together. Da Vinci was born in 1452, Bartolomeo in 1469, Michel Angelo in 1474, Titian in 1480, and Raffaelle in 1483.

In a rapid and concise history of art to detail the inferior names, who gradually by little and little, conduce to the ultimate expansion of genius, is impossible. A historian of this description has only time for leading points, or headlands in the voyage; he has not leisure to dive into every little cape, bay, and projection, which by degrees, push the mainland into the ocean. The older painters of the Roman school will not add much to the interest of the art; and a fair estimation of Raffaelle and his glorious school, is much more likely to benefit the student, and instruct the general reader. It is not, on the whole, morally just; but many eminent men become thus swallowed up in the blaze of their successors. As Shakespeare nearly deadens all feeling for previous excellence, so does Raffaelle, though Shakespeare, Michel Angelo, Raffaelle, and Titian were all indebted to their predecessors.

If Julius was adapted for Michel Angelo, Leo X. was peculiarly so for Raffaelle; though Mengs says that the honours and indulgences he received from Leo, made him luxurious and idle, and that he was not so industrious as during the short reign of his first patron Julius. Yet his rapid advance from the first picture he painted in the Vatican, to the Heliodorus, is extraordinary; and, as according to Vasari, he sent artists to draw for him in Greece, there is no doubt that he had a sketch of the pediment of the Parthenon, before it was blown up, and that the Heliodorus is but a skilful adaptation of the Ilyssus. He was so much overwhelmed by employment and honours, that his latter works in the Vatican were wholly placed in the hands of his pupils, and carried on with the spirit of a manufactory. He was then appointed architect to St. Peter's at the death of St. Gallo, which distracted his thoughts. Incessant application, and incessant thinking of course weakened his delicate frame, nor did the capricious and harrassing attendances on such a court increase his strength; added to which the maddening love of women for one so highly gifted and so handsome, his own devoted passion for Fornarina, and the endless demands on his brain, brought him to the grave at thirty-seven, absolutely borne down, like Byron, by excitement of every description, nervous, bodily and mental. This is the way with the world; they kill a favourite by kindness, and an offender by cruelty.

In some life of him an attempt was made to prove that he caught cold by hurrying from his work to the palace at the Pope's order, and standing while in a profuse perspiration in a draught. But that is no refutation of the previous causes; the question is, what prepared him to be killed by such a cause? Incessant work and dissipation; no painter can do both. Of course princes must be obeyed at any expense; they seem to feel little for their dependants, as if in revenge for being themselves deprived of so many enjoyments by ceremony and etiquette. Napoleon used to take great delight in never suffering old German maids of honour with fifty quarters in their arms to sit in his presence.

His last work, according to Mengs, was his Transfiguration in oil, a work deficient in masterly execution, and having a laboured look of smoothness. In drapery, in character, and in expression it was fine; but in the Louvre it looked small. By the side of Corregio, it seemed hard; by that of Titian, raw; by that of Tintoretto, tame; and the Christ's head was not equal to Corregio's at the National Gallery. It was not an example to hold forth to a young man as faultless. The Cartoons at Hampton are finer in point of execution alone; they are his finest works for all the requisites of art. He was not restrained by designing for tapestry; his genius was put forth with a Venetian power of brush; and there are heads equal to any, especially the frightened woman's head in the Ananias, in these wonderful works.

In beauty he was far inferior to the Greeks; in form he could not approach them; in composition he was perfect; in expression, deep; and in telling a story, without a rival. Taking into consideration all the great men in modern art, this young man, not highly educated like Rubens, must be placed on the throne, till one arises who shall have what he had not, in addition to his own perfections; and that young man will probably arise in Britain. He was an extraordinary creature; modest, timid, and amiable; affectionate to his equals, and gentle to the highly-born, his premature death gave a shock to Rome, which those only can estimate, who know the depth of Italian sensibilities. But did he die too young? Not at all. He might have decayed, or he might have become more luxurious and more neglectful. No man dies too young who dies with all the sympathies of the world unexhausted about him. The *furor Raphaelis* is the best species of fury that can seize a young student. He has no manner, no affection, no vice, no grand style; all is simple, natural, and unaffected. His women are creatures of gentleness and love, though none are perfectly handsome. Perhaps he was more adapted for the characteristic heads of apostles than the naked forms of Greece; in fact he was a great Christian painter, and seemed born to extend the influence of Christianity by his art.

His father being a painter, he began early of course, and at sixteen, had painted a picture at Castello, the composition of which was in advance of the age. At seventeen he painted another of the Virgin and child. In the Sacristy, at Sienna, he assisted Pinturichio with designs; in 1504, he went to Florence, where Michel Angelo and Da Vinci were making a great noise with their cartoons for the hall; he studied both, and improved his perspective and colour, in connexion with Bartolomeo. When Bramante, his uncle, who was architect to the Pope, advised his Holiness to send for Raffaelle, the pope consented; and in April 1508, Raffaelle entered Rome, and was admitted into the Vatican.

From the continual occupations of Raffaelle in his art from boyhood upwards, he could not have had a classical education to any great extent. He knew a little Latin, as all Catholics did; but he was intimate with Bembo, Castiglione, Ariosto, and Aretino; and these men must have helped him in historical or philosophical knowledge, or moral allegory, for the completion of his great works. Raffaelle left a noble school; and as soon as grief for the loss of their master had subsided, his pupils set about completing the works he left unfinished. The battle of Constantine was done by Julio Romano and Perino del Vaga. As Raffaelle lay in state, the Transfiguration was placed at the head of his coffin.

Julio Romano.

Julio Romano was the most eminent of his pupils. With vast poetry of mind, he did things in a style of execution, which renders him the purest poet in his art. His sun setting, and moon rising over our heads, in the Palazzo del T, is nowhere equalled or approached. Though he put forth his genius at Mantua, he was a Roman in practice, and to Raffaelle owed the elements of his art. His colour was crude and his execution harsh; yet no one can fail to see in his works, the real poetry of painting. Polidoro was another great man of the same school. He was originally a mason's boy, and used to prepare the walls for fresco; but he got interested in seeing the young men at work, tried to draw himself, and Raffaelle having assisted him, he became an eminent painter.

It is interesting to reflect on the affection with which Raffaelle was surrounded. He never went to court without being attended by fifty gallant artists. Little must he have made others feel his superiority; and for once a man of genius seems to have made envy smile. Though there is an instinct in the world, the moment a man of genius appears, yet it depends upon himself whether he is received as a blessing or an annoyance. Mankind will assault the man who attempts to command by superiority, instead of leading by courtesy; but they will hail him let his superiority be what it may, who seems willing to help his inferiors with kindness, or supply their want of knowledge, as if they were doing him a favour to listen. The whole of this is based on goodness of heart, tender sympathies, and a consciousness without the appearance of conceit.

Decline of the Roman school.

The glory seems to have gone from the Eternal City after Raffaelle's death. In 1527, Rome was stormed and taken by foreign soldiers. The savages bivouacked in the Vatican, and injured the frescoes by their smoking and fires. Sebastian del Piombo attempted to repair them after the soldiers were gone; and Titian, when in Rome, not knowing Sebastian, actually asked him who had been spoiling those beautiful heads? The art went on sinking rapidly till 1595. Raffaelle had been dead seventy-five years; Giorgione, eighty-four; Corregio, sixty; Michel Angelo, thirty; and Titian, nineteen. When the usual apprehensions of getting on a lee-shore seized the patrons and the artists, and the usual signal of distress was hoisted, Muziano, a pupil of Titian, founded St. Luke's Academy in order to raise a new batch of Raffaelles and Corregios, and save the noble vessel. The only man who since dazzled for a moment, was Michel Angelo Caravaggio. He had great and original talent, though founded on common nature, without any abstract notion of form, any conception of beauty of women, or any refinement in anything. With a sledge-hammer for a pencil, he seemed resolved to batter down all opposition; and by fierce extremes of light and shade, bearded men, dead Christs, and Transteverine beggars for apostles, he founded a school, got a character, and raised a name, which cannot be forgotten in the art of Europe.

Lanzi seems to class in the Roman school every body who practised there for the last three hundred years, but that is not fair. On this principle, all the Flemings, Dutch, Germans, Russians, Spaniards, and English, may be of the school, because they studied there; and Rubens, Vandyke, Velasquez, the Caracci and their pupils, as well as our Reynolds, were, on the same principle, of the Roman school. About the seventeenth century, this eminent school, in spite of the academy of St. Luke, went on declining. Birth, destruction, and reproduction seems to be the principle of every thing physical, but not of moral or mental powers. Lanzi attributes this decay to any cause but the right one; namely, the *absence of genius*, the great primary cause, and which no academy can ever supply.

Cortona, Bernini, and Sacchi, were the heroes of this day; Cortona, Bernini, and Sacchi.

and at a later period appeared Carlo Maratta. Raffaelle became to him a substitute for nature; though in 1689, he gave sufficient tone to art, to induce Clement XI. to employ him. But here, as well as elsewhere, genius was wanting. Carlo was as heavy as the lumbering folds of his own drapery; and so insipid are his large pictures, that it is a question whether they did not generate in Europe a contempt for large scripture subjects, which has lasted ever since. However, imbecility had not done spawning; and in a faint struggle for offspring against nature, out came Pompio Battone, and Raphael Mengs. To complete the farce, academies began to be founded in France and in the rest of Europe; and Pompio Battone, and Raphael Mengs may be looked upon as a very fair sample of what academies can produce, have produced, and will probably produce to the end of time. Mengs was every thing but a man of genius. He was a bad painter and a deep critic; and his predicting that we had not the works which the ancients esteemed the most, was verified, in a most astonishing manner, by the discovery of the Elgin marbles. The prediction does honour to the sagacity of Mengs. Thus end two great schools of form, conception, expression and composition; the Florentine and the Roman. But of these the Roman was unquestionably the greater.

We now come to the Venetian, a great school of colour, Venetian school.

light and shadow, impasto, and execution, completing the imitation of reality; and in summing up the character of Italian and Greek art, we shall see that these components of imitation, each of which characterised an Italian school, were combined in all schools, as a necessary requisite in the perfection of Grecian imitation.

The most ancient work of Venetian art known, is in Verona, in the cellar of a monastery, (Santi Nazario a Celso). It is inaccessible to the public, but can be seen in the woodcuts of Dionisi. In the part which formed the oratorio of the faithful, has been painted the mystery of redemption; it is a work of 1070, when the Doge Silvo invited Grecian mosaic painters to adorn St. Mark; men who though rude in art, could nevertheless paint. Thus commenced the art in Venice, whither, after Constantinople was taken by the Venetians in 1204, Greek painters and sculptors, as well as orefici, flocked in crowds.

In the thirteenth century, painters had increased so much, that a company was formed, like the English constituent body to which Hogarth belonged, and laws and constitutions were made. Things were proceeding in this train when Giotto, returning from Avignon, painted at Verona and Padua. Nothing of his, however, is left in Verona; but at Padua the remains of his works are still quite fresh in fresco, and full of grace and vigour. Such was the early beginning of this great school, in which it will be seen that Greeks, as usual, had the first hand. Various names sprung up in this period, but the Bellinis are the most important. One of them was engaged by Mahommed II. and by his talents upheld the honour of the Venetian name; another was the master of Titian and Giorgione, two of the greatest names of the Venetian school.

Giorgione. Giorgione was a great genius; and his execution was entirely above vulgar prejudices. He saw and seized the leading points of leading objects, and hit them with a touch and an impasto, of which he had no previous example even in Leonardo. His breadth and tone were beautiful; and he first opened the eyes of Titian to the superior value of breadth and touch, as compared with over-wrought labour and smooth finish. Giorgione died in the vigour of his life, to the great loss of the art; for there is no knowing how much farther he would have carried his principles, or how successfully he would have disputed the crown with Titian. Lord Carlisle has a small picture by this eminent man, of a youth buckling on the armour of a knight, which is exquisite in tone, brilliancy, depth, and feeling; and had he not been cut off by the plague, there is no knowing how far he might have gone. He certainly first opened Titian's eyes to the value of breadth, and that comprehension of mind required to seize the leading characteristics of objects by a touch, leaving the atmosphere to finish at a given distance. After his death, Titian was without a rival. This great painter began, of course, like all Venetians, to paint directly from nature, without having previously dissected or drawn; nor was he sensible of this error of the Venetian school, till coming to Rome and seeing the works of Michel Angelo, Raffaelle, and the antique, he, like a great genius, set about remedying his deficiency; and the perfection of this union of form and colour is seen in his greatest work, Pietro Martyre, any attempt to move which from Venice, the Venetian senate decreed should be punished with death. This picture occupied him eight years; and eight years were well spent in such a production. The terrific gasping energy of the assassin, who has cut down the monk; the awful prostration of the monk, wounded, and imploring heaven; the flight of his companion, striding away in terror, with his dark mantle against a blue sky; the towering and waving trees, the entrance, as it were, to a dreadful forest; the embrowned tone of the whole picture, with its dark azure and evening sky, the distant mountains below, and splendid glory above, contrasting with the gloomy horrors of the murder; its perfect, though not refined drawing, its sublime expression, dreadful light and shadow, and exquisite colour; all united, render this the most perfect picture in Italian art. Why does not one perfect work entitle a man to rank as highly as a series of imperfect works, like the Capella Sistina? The answer is, because there is greater range of capacity shewn in a series of conceptions to illustrate a theory, than in the completion of one work alone, although all the component parts may be perfect; and Raffaelle, and Michel Angelo, will ever rank higher than Titian, as Polygnotus will rank higher than Protogenes or Apelles. Prolific thinking, is surely of more value than intensity of imitation, though intensity of imitation must be added to realize the idea of a perfect painter.

Titian. Titian began in the style of his master Bellini, with the most minute finish; a capital basis for future practice, if a man have comprehension to know when to leave it, as Titian did. To shew the young artist that it is never too late to improve, let him compare the Bacchus and Ariadne in our National Gallery, when he could not draw finely, with the Pietro Martyre when he could. In modern art, he was the only painter who hit the characteristic of flesh. Every great painter's flesh is paint; Titian's had real circulation of blood under the skin. On comparing the Ganymede, in our National Gallery, fine as it came from Titian's pencil, with the Theodosius by Vandyke, which is close to it, as fine a specimen of Vandyke's fire of brush as can be seen, the heavy leathern look of Vandyke's colour excited astonishment. In the flesh of Ganymede, colour, oil, brush, and canvass, were all entirely forgotten; it quivered, it moved with the action of the limbs. In Vandyke, the materials of art are uppermost; you think of them, you wonder at the touch, you forget the subject, the expressions as it were scenting of the painter's room and the easel. And so you do with all the Flemings, but never with Titian. Though we have fine Titians in England, the Diana being at Lord Egerton's, and a head at the Duke of Sutherland's; yet it must be confessed, that the Louvre possesses Titians more perfect, especially the entombing of Christ. In Josephine's collection at Malmaison, there were a Venus and Cupid, as perfect as our Ganymede, and not injured by *restoring*, the fatal propensity of the French. In Titian whenever you see the blues sober and in harmony, the picture is uninjured; whenever you see them harsh and too brilliant, they have been rubbed, and the last tone has been taken off.

In colour, he was never equalled; in execution of the brush, he was quite perfect; and in character and expression of portrait he was like Reynolds elevated and sublime; but the dullness which portrait, if perpetually practised, engenders in the capacity to idealise and elevate, rendered his conception of poetical characters defective. Nothing can exceed his Aretino, his senators, and his popes; nothing can exceed Sir Joshua's Lord Heathfield and Mrs. Siddons; but nothing can be meaner than some of Titian's attempts, like Raffaelle, at high poetical expression, except some of Reynold's heads in the Beaufort. The nerve and beauty of the colour in Diana and Acteon are so touching, that one can almost fancy one hears the water ripple and the leaves wave. Glazing was the great feature in his tone, as it was in that of Apelles; and there is no perfect colour without it.

The first requisite in fine colour is the ground or preparation spread over the canvass to receive the colours. It is either of a nature to absorb the oil, or to resist the absorption. If it resist the absorption of the oil out of the colour put on it, it is an oil-ground; if it absorb the oil, it is a water-ground. And it has long been an interesting question, whether the Venetians used an oil-ground or an absorbent ground; whether, like the Greeks, they worked in tempera, and varnished out, or whether they judiciously mingled both oil and tempera together. One would think that Vasari, living as he did with all the great painters, could not be ignorant of their various methods of practice. In 1567 or 1568, he called on Titian, saw him, staid with him, was in his painting-room, and must have talked on art, and perhaps dined or supped with him.[1] But Vasari distinctly says, in a sort of recipe-introduction to his lives, (edition 1568) "that the ground on wood was *gesso*, plaster of Paris; that

[1] All the great painters seemed to prefer *supper*. In Tichozzi, Titian seems to have been a sociable man, and there are extracts from Titian's and Aretino's letters, alluding to pheasants, and presents of birds for the *next supper*.

Painting.

then they mixed three colours, white, yellow, and amber, and spread them equally over the white ground; and that after tracing their cartoons, they painted their pictures." A more abominable ground never was mixed; to those who have an organ of colour it is an absolute emetic; and though it might have been Vasari's and the Florentines' ground, it never could have been endured by the eye of a Venetian. "This was the method," says Vasari, "for pictures on wood; but when canvass became the fashion, gesso being likely to crack in ceiling, they made a ground of flour *(farina)*, white lead, and nut-oil, after the canvass had been smoothed by size."[1]

Now when this was published, Titian, Tintoretto, and Paolo Veronese were alive and all at work; and it is but common sense to conclude, that had it been false, they would have contradicted it. Vasari concludes with saying, "So are painted all the great works in St. Mark's Place, Venice." In that place was the Miracle of the Slave, by Tintoretto, afterwards seen by every body in the Louvre. Lanzi says, that the Venetians preferred canvass, but that at first they painted in tempera, and then came oil-painting, which the Venetians first adopted. On the arrival of the Bacchus and Ariadne in England, a little bit chipped off at the corner showed the ground underneath to be of the purest white. Now, if a white ground is absorbent, it sucks the oil out of the oil colours, and becomes the colour of oil. Sir Humphry Davy said to the author of this article in 1823, that in process of time oils become varnishes; and it is not impossible that the white ground of Titian may have been absorbent, and though it had sucked out the oil in the course of three hundred years, it may have recovered its original whiteness. The author's experience extends only to thirty years, and in that period an absorbent ground which sucked out oil has never recovered its whiteness.

But, if the Venetians painted first in tempera upon the white ground, and finished in oil, the tempera intervening between the last painting and the ground would preserve the ground white; and as Titian's method of proceeding was gradual and progressive in successive layers, like that of Protogenes, so that each layer became a help to the succeeding one, there is no reason to doubt that tempera might have been the first impasto. In parts of the Pietro Martyre, there certainly was the crude look of tempera preparation, softened by a glaze, especially about the projecting leg of the assassin. That the basis of Venetian pictures was a white ground, there can be no doubt; like the intonacos of Apelles, and the plaster-grounds of the painted mummy-coffins of Egypt. Tintoretto and Bassano used dark grounds to save trouble; but they are ruinous. They come through the thin half-tints of the picture, and render it distinct masses of dark and light, like most of the Lombard school. Many of the works of Paul Veronese, who painted one hundred years before, were in perfect preservation in the Louvre, whilst a number of the Lombard pictures were gone. The white ground was the "luce de dentro" of the Italians, "the light within." Upon this beautiful white ground they placed their colours purely and crudely, and then by spreading thin transparent tones, took down the rawness, without losing the force of the tint. This was the practice of the Greeks, and is also the present practice of the British school. When Cicognara, the president of the Venetian academy, was in England, he remarked to the author on the singular fact, that the British was the only school of colour left in the world, though our climate was the worst; and such was the state of Venice some years since, that an English consul could get nobody to paint the king's arms for him, and being the son of a painter, he was actually obliged to paint them himself.

As an example for the student, Titian is perfect. His execution never attracts by itself alone, but as the vehicle of the object it imitates. In colour he is never gaudy, never black in light and shadow, never forced or affected, and in drawing, latterly, grand. In composition he was not so perfect nor so fertile as Raffaelle; but in the imitation of flesh, no other artist in the world, except Apelles perhaps, could rival him. As a painter of portrait and landscape, no one has surpassed him. He did not grace his senatorial heads with the beauty of the backgrounds of Reynolds or Vandyke; but the absence of all gaiety behind the heads, perhaps added to the sublimity of their expression. It is curious to read in Boschini's little work, that young Palma, who had it from old Palma, a pupil of Titian, told him that Titian very often finished with his thumb. Palma distinctly says, that he has seen Titian put on with his thumb and fingers masses of colour which gave life to a picture.

In a word, neither of the great Italian schools showed the sense of the ancients. The Romans omitted colour and imitation from sheer accident; the Venetians drawing and form; and Reynolds, without going into the causes of these mutual deficiencies, laid it down as a principle, that colour and reality were incompatible with high art; whereas, when each school found out its deficiency, each endeavoured to correct its peculiar defect.

Tintoretto.

The giant of Titian's school was Tintoretto, who gave such early indications of self-will and genius, that Titian, mean and jealous, turned him out of the house. Raffaelle would not have done this; he did not turn out Julio Romano. But Tintoretto was not to be crushed by the bad passions of his envious master; and took it very properly as an evidence of his talent. And what did Titian get by his paltry meanness? Nothing but pity. Tintoretto, young as he was, immediately formed a plan of his own, for combining the drawing of Michel Angelo with the colour of Titian. He devoted the day to the one, and many parts of many nights, and often whole ones, to the other. In a few years, the result was the Miracle of the Slave and the Crucifixion. Although the execution of Tintoretto looked daring and impudent by the side of the modest, senatorial dignity of Titian, yet there was a grand, defined dash about it. The original sketch of the Miracle of the Slave, is in the possession of Rogers the poet, and is a very fine thing. Every body speaks of the Crucifixion as a wonderful instance of power. But in colour it is lurid and awful; in expression, character, and delicacy of feeling, discordant and offensive. His pictures seem to be a mass of fore-shortenings, affected twistings, dashing darks, and splashing lights, with a hundred horse-power of execution; bearded heads, Venetian armour, silks, satins, angels, horses, architecture, dogs, water, and brawny-armed and butcher-legged gondoliers, without pathos, passion, or refinement. He used to put little models in boxes, and light them in different holes, for effect. Like all Italians, he was accustomed to model and hang up his models by threads for fore-shortening. His style of form was a mixture of the pulpiness of the Venetian, and the long, anatomical, bony look of the Florentine school. He cannot be depended upon for correctness of proportions, but he was a grand and daring genius; and his conduct, when oppressed by Titian, should ever be held up as an example for the aspiring youth, when trodden upon by his elders.

Paul Veronese.

Whilst Tintoretto was astonishing the Venetians by his daring, which made even Titian tremble, Paul Veronese, the other great contemporary, was mildly pursuing his azure and beautiful course. Of a nature the reverse of Tintoretto, and not equal to him in sublimity or terror of conception, he yet gave equal evidence of being run away with by his brush. Ceilings, canvass, halls, walls, and palaces, were so many proofs of his power. His greatest work is at Paris. It is the Marriage of Cana, a wonderful instance of executive power;

[1] This is Vasari's account, pp. 51, 52, 53, Firenze, volume i. 1568.

but here all story, sentiment, and pathos, are buried in the noise, bustle, eating, drinking, and fiddling of a Venetian city feast. Paul Veronese was certainly the most corrupt painter of the time.

Cannaletti,

After these great men, the art began to decay; and Paul Veronese and Tintoretto gave symptoms of a conventional mode, which, when taken up by inferior men, hastened its ruin. Down to the present age, with the exception of two or three mannerists, no name occurs worthy of eminence or selection. Cannaletti was a genius in his way. Sebastian Ricci, and Marco Ricci, were much employed in England to disfigure ceilings and palaces by wholesale, with gods and goddesses, in subjects allegorical, poetical, mythological, and nonsensical, to understand which it required pages of explanation, and to see which a nine-feet telescope by Dolland. Montague, Burlington, and Bulstrode houses, are signs of the infatuation of the English nobility at that time; an infatuation, however, which shewed a disposition to employ art as it had been employed in Italy, and if the genius had been equal to the opportunity, the result would have been different.

Lombard and Parman school.

The next school of any importance is the Lombard school, which comprehends the Mantuan, the Modenese, the Cremonese, and the Milanese. Andrea Montegua is the hero of the Mantuan school, and Vasari says, that his master-pieces are the tempera designs which we have at Hampton Court. They are fine things; Rubens used them; and they are a mine of costume, though the forms have too much the look of the model. Julio Romano's great work is at Mantua, yet he must be considered as a Roman. It was, as Lanzi says, the greatest effort of the last style before Leonardo da Vinci introduced a new one, which overturned the Gothic. After Julio Romano, the art decayed, and then of course came the old story, "Una accademia per avvivarla." This academy has been splendidly kept up by Austria, and, as usual, has not produced a single man of great genius, in three hundred years.

Corregio.

Contiguous to the Modenese school is the Parman; and now we come to the most unaccountable and delightful of all painters, Corregio. When it had been determined to ornament the great cupola of St. John, Corregio, though then a young man, was selected to paint it; and, like Raffaelle, his genius expanded with the opportunity. After Raffaelle, Titian, Michel Angelo, Da Vinci, and Bartolomeo, who would have thought that another style, independent of either, and unlike any thing else in the world, could have burst out? But so it was. Of all the painters that ever lived in the world, there is no accounting for Corregio. Unlike Greeks, Romans, and Italians, out he came into the world, in colour, drawing, light and shadow, composition, expression, and form, like nature, and unlike every body else, who ever studied nature at all. Michel Angelo, Raffaelle, Titian, we can trace; we see upon whom they were grafted, when they budded and burst forth. But who is Corregio? Nobody is certain. One swears he was poor, another that he was well off; another says he died in consequence of a fever which he caught by carrying all his money in copper, the price of a picture; another protests it was no such thing. Meng's account is the best, and Vasari's mostly without authority.

There is no certainty that his portrait is in existence; in fact there is as much dispute about it as there is about Shakespeare's; and here are his beautiful works, his Notte, his Catherine, his Christ in the Garden, his Magdalene, his Venus and Mercury, and his *Ecce Homo* in the National Gallery, the only head of Christ in the world. This head of Christ ought to be reverenced as the identification of the character, as much as the head of Jupiter by Phidias was in the Pagan world. There is no Christ's head by Raffaelle which at all approaches it, either in the Transfiguration or in any other work; and the head by Leonardo da Vinci in the gallery cannot be endured after it. Of all painters, he astonishes one the most. If any fault is to be found with him, his men have a touch too effeminate. His colour is exquisite; his light and shadow are enchanting, but his forms defective; his composition is simple and infantine; his expression unimpassioned, but sweetness itself; and when sorrow or suffering was to be represented, who ever did it more tenderly than Corregio? Let any man who doubts this, dwell for a moment on the gentle suffering, and the feminine yet manly beauty of the Christ above mentioned. It is the very Christ who commanded by submission; without weakness beautiful, without effeminancy tender; without taint the personification of love. His hands, his shoulders, his beard, his hair, belong to that divine being who vanquished sin, by yielding to torture. It does not seem painted, but as it were spread upon the canvass by an angel's breath. His men look as innocent as girls; his women as guileless as infants; and his infants as if they had just come from the skies.

In the cupola at Parma, the great wonder is the foreshortening; and in the mouths of the vulgar this is technical perfection; whereas there is nothing more purely mechanical, nothing in fact you can so easily teach. One single smile of Corregio's angels, one touching look of Raffaelle's apostles, the sentiment of the Duke de Lorenzo by Michel Angelo, one crimson tone by Titian, are worth all the foreshortening on earth. The greatest excellencies of Signorelli, Buonarotti, and Corregio, are said to be their foreshortenings; whereas the greatest excellencies of Buonarotti and Corregio are not their fore-shortening at all.

In spite of the perfections of this wonderful man, he founded as it were the decay, "le commencement de la fin." His breadth in fresco produced Lanfranco, Cortona, and Giordano, who covered Italian palaces with the *sweeping* brush of our patent chimney-cleansers, beginning it in the morning, finishing it by the evening, standing on the floor, and disdaining a scaffold, previous study, or previous thinking; and others came who bedaubed the palaces of Europe with clouds like feather-beds, cornucopias and Jupiters, till one's brain aches in thinking of them.

Reynolds was immensely indebted to Corregio; for Rembrandt and Corregio are certainly the bases of his style. One of the most beautiful works in the Louvre was the Marriage of St. Catherine, which when once seen haunts us in after life in dreams. In a word, Corregio was an angel that passing this earth in its flight, drooped its wings and dropped upon it, to give us a foretaste of the smiles which welcome a happy spirit in a purer sphere.

Parmegiano is the next important name in this school, who grafted the grace of Corregio on the affectations of Michel Angelo. His greatest work is in our National Gallery; the Vision of St. Jerome. The Christ is a beautiful boy, but affected; the Virgin is Michel-Angelesque, having the *glumdalclitch* look of his Brobdignaggian women. St. John is finely drawn, but not unexceptionable; and the St. Jerome is sleeping in a position as if he had got into a cramp in the first part of the vision, and could not get out till it was over. It is raw in colour, skinned in construction, and spoils the composition altogether. His small pictures are beautiful but long in proportion. His fingers seem always to move to music; and his limbs to be conscious how gracefully they are disposed. He has often been a fatal example to the young. Nor is his Moses, whatever Gray may say of it, an instance of the sublime. The expression is mean, and the form overdone. Parmegiano died, like Raffaelle at the age of thirty-seven, when all that was expected of him had not been realised, and when, if he had lived longer, perhaps he would have done worse. Parmegiano.

In 1570, the best Corregieschi were grown old or dead, and the school of Parma began to give way to that of Bologna, the truly great academical school. This was not an academy in the modern sense of the word; it was a school, and nothing but a school, without distinctions, and managed School of Bologna.

by directors; and it is the only academy which has ever produced any genius. Dominichino, Guido, and other names of the second period, came between unrivalled excellence and approaching destruction, and stopped for a little time the decay of the art.

Of the Cremona school, there is no great name. In the Milanese school, Da Vinci seems the hero; he founded an academy which, according to Lanzi, was the first in Europe that reduced art to rules, the works of Leonardo being the canon. His great work is in the refectory. But fifty years afterwards Aramini says that it was spoiled; in 1642 Scannelli writes, that it was with difficulty made out; and Barry ultimately saw it destroyed by a *restorer*. When Eugene Beauharnois was viceroy of Italy, he drained the refectory and had it paved with tiles; and it is said in a report, that the colours began to revive. Da Vinci's academy having produced no talent, Maria Theresa founded another, which, though full of casts of every description, has nevertheless proved equally unsuccessful.

The Caracci and their pupils were the last crop of genius which Italy threw up, and though they were second-rate, they came of the breed of the great who were no more. The style of Michel Angelo seems to have taken early root in Bologna, perhaps from his executing in that place the statue of Julius II. Giotto, in the first instance, excited emulation by flying about Italy; but he seems to have scattered everywhere the seeds of art, and Tibaldi, after having studied in Rome, certainly founded this style at Bologna. The first school formed was by Bagna Cavallo, and Primaticcio. It failed in 1564; upon which Primaticcio went to France, and Tibaldi to Spain, and the art was of course neglected.

The Caracci succeeded them and were extraordinary men; but what would they have done if Raffaelle, Michel Angelo, Titian, and Corregio had never lived? They saw nature only by the help of their great predecessors. Whatever the Caracci did had the appearance of labour; whilst whatever was done by their great predecessors, had an air as if there was something that no labour could attain. Ludovico had more feeling than his brothers, and had the honour of being instructed by Tintoretto. They were the sons of a tailor, and founded an academy in their own house. Agostino principally engraved, and Annibale principally painted; but they each contributed instruction to the school in which were formed Dominichino, Guido, Lanfranco, Guercino, and Albano.

Guido, Guercino, and Albano.

The greatest genius of the school was Guido; but he was envied by the Caracci; and even in this school the vices of an academy began to appear. We did not find Raffaelle sowing discord amongst his pupils by putting one against the other. Albano was opposed to Guido. Dominichino was an eminent but heavy genius; and his communion of St. Jerome is a fine thing though dull. There was a vulgar grandeur about Guercino, and an insipidity about Albano. The great work of Annibale Caracci is the Farnese gallery, which is excellent in every thing, but nerve and genius. Say what you will about the Caracci, there is a want in their art, which affects the pen of him who is attempting to do them justice. They lived together, did not marry, and were ill paid and ill-tempered; like all old bachelors they were discontented, they did not know why, and fidgety, they did not know for what; they envied the talents they were desirous of bringing forward, called the art their "wife," and were never satisfied, living in a perpetual fret of teaching, and painting, and complaining. Annibale became dissipated and died early. It is an extraordinary feature in the moral character of the Italian artists, that the greater part did not marry, and hence came the cant "of the art being their wife," with the natural consequence, that girls who had been models generally ended by being mistresses.

The Caracci kept up this affectation, they said the art was their "cara sposa;" and to all the confusion of a bachelor's house, added the slang of a mere painter's habits. At the dinner-table, crayon and paper were always at hand to catch attitudes, actions, and expressions, and groups; as if expressions and attitudes could not have been remembered in the solitude of the study, and kept till wanted with just as much effect as this vulgar intrusion on the usages of society. A great artist is always a man of the world; an inferior one a man of the palette. Raffaelle, Titian, Angelo, Rubens, and Reynolds, would have passed a twelvemonth in any society without being discovered to be artists; but the Caracci would have talked of tone and touching during the first half-hour. A genteel woman, accidentally travelling in a coach with three artists who were *palette-men*, expressed afterwards her wonder and suspicion as to the state of their intellects. For after the usual dead silence, one of them said, with an air of vast profundity: "How finely the white sheet in the hedge carries off the colour in the sky." "And look at that old woman's cloak taking up the brick-wall," said another. "Yes," said the oldest of the set, "how finely it was done yesterday by a red night-cap in a pretty bit of Sir George." Johnson used to say, "Sir, we were reduced to talk of the weather." But even the weather is preferable to this detestable affectation. Though the deepest principle of the ancients was the preservation of beauty in everything, they never sacrificed beauty to expression, but always combined the two; whereas Guido, by an eternal repetition of the expression of the Niobe in Christs and Virgins rendered the preservation of beauty at such an expense insipid. The beauty of the Helen and Paris was truly exquisite; but hundreds of Herodias's daughters with St. John's heads, "have a look," as Lord Byron says, "of bread and butter." His grace was the grace of theatres; his pencil light, airy, and beautiful, though rather careless than masterly. Dominichino, on the other hand, obedient, slow, and timid, imitated everybody and fell short of all. But Guercino was the most original of the school; his finest manner is his candlelight manner, yet still there is a vulgarity in his forms.

None of the Caracci or their school, had they been born at an earlier period, would have advanced the art one iota beyond their predecessors, so entirely dependent were they upon the great who had gone before. "Such was the state of art," says Fuseli, "when the spirit of machinery destroyed what was yet left of meaning;" when contrast and grouping meant composition and thinking, and a mass of rapid, thoughtless, empty, impudent frescos disgraced the walls, palaces, and churches of Italy. Pietro of Cortona and Luca Giordano are the heroes of this inundation of splashiness; and yet what artists they were! The decay which it announced, was the decay of the giant Italian fresco hand that still struggled to do its duty, whilst the head was fast approaching imbecility in thought. The meanest pupil of the meanest machinist would have swept the first-rate British artist that has ever yet existed into the earth, with his tiptoes and exhibition-glare.

Decline of Italian art.

Thus, with the Caracci and their school, ended the greatness of Italian art; nor has there been one single painter of such genius since, from Andrea Sacchi to Cammucini the present hero of the Romans. Rubens, Vandyke, and Rembrandt turned it into a new channel in Flanders; Velasquez and Murillo kept it alive in Spain; Teniers, Ostadt, and Jan Steen preserved it from extinction in Holland; the Poussins, Claude, and Salvator, meanwhile revived it in Italy; whilst the old Gothic masters in Germany, with their colour, and most of them with great invention but in bad taste, were an absolute dung-hill of diamonds and pearls, which everybody has considered himself as having a right to plunder, not even excepting Raffaelle himself. Whilst the art was sunk to the lowest depths in Europe, Reynold's in England broke forth with a brilliancy of colour which has rendered it no longer a hopeless attempt to rival the gorgeousness of Venetian splendour. If ever there was a refutation of Reynold's own theory, that "genius was the child of circumstances," he was a living one; in spite of all circumstances, in spite of the utter want of all education as a painter, in spite of all the apathy of the nation, and the extinction of art in Europe, out he came with a vigour and beauty which have ever since defied rivalship in portrait and children.

The Germans are an extraordinary nation, but always more or less under the influence of a wrong taste. Their early painters are full of thought; and as a proof of what Raffaelle's estimation of them must have been, he adopted almost to the letter, in his famous Spasimo in Spain, Shoengaer's magnificent composition of Christ bearing the cross. The hand leaning on the stone, with the momentary action of the drapery, is in Shoengaer. The brute pulling Christ, in an old German dress, Raffaelle has taken and improved; and he has also placed the Marys in the fore-ground which Shoengaer placed in the back-ground; but the whole of the composition is Shoengaer's, though Raffaelle of course has added to it his own perfections.

Albert Dürer is considered as the greatest man of the German school; but there is nothing which he has ever done that can compete, in expression and composition, with this fine production of Shoengaer's. Fuzeli says, "Albert Dürer was a man of great ingenuity, but not of genius. His proportions of the human figure are on a comprehensive principle founded on nature, and the result of deep thinking." He had sometimes a glimpse of the sublime, but it was only a glimpse. The expanded agony of Christ on the Mount of Olives, and the mystic conception of his figure of Melancholy, are thoughts of sublimity, though the expression of the latter is weakened by the rubbish he has thrown about her. His Knight, attended by Death and the Fiend, is more capricious than terrible; and his Adam and Eve are two common models shut up in a rocky dungeon. "If he approached genius in any part of his art, it was in colour; his colour went beyond his age, and as far excelled in truth, and breadth, and handling, the oil colour of Raffaelle, as Raffaelle excelled him in every other quality. I speak of his easel-pictures; his drapery is broad though much too angular, and rather snapt than folded. Albert is called the father of the German school, though he neither reared scholars nor was imitated by the German artists of his or the succeeding century. That the exportation of his works to Italy should have effected a temporary change in the principles of some Tuscans who had studied Michel Angelo, as Andrea del Sarto, and Jacopo da Pontorino, is a fact which proves that minds as well as bodies may be at certain times subject to epidemic influences."

Lucas von Leyden was the Dutch caricature of Albert Dürer; and ere long the style of Michel Angelo was adopted in the same way as by Pelegrino Tibaldi, and being spread by the graver of Giorgio Mantuano, provoked those caravans of German, Dutch, and Flemish students, who, on their return from Italy, introduced at the courts of Prague and Munich, in Flanders and the Netherlands, that preposterous manner, that bloated excrescence of swampy brains, which in the form of man left nothing human, distorted action and gesture with insane affectation, and dressed the gewgaws of children in colossal shapes, in the style of Golzius and Spranger. But though content to feed upon the husks of Tuscan design, they imbibed the colour of Venice, and spread the elements of that excellence which distinguished the succeeding schools of Flanders and of Holland. At this moment out blazed upon the world that giant of execution and brute violence of brush, and brilliant colour, and daring composition, Rubens; and another mysterious and extraordinary being, Rembrandt, who seemed born to confound all theory but that of innate genius, confirmed it for ever. Rubens gloried in the splendour of the rainbow, whilst Rembrandt enjoyed only the poetry and solemnity of twilight; when the evening star glittered, and the sun was down, then was the hour of his inspiration.

The scholar of Otho Venius, Rubens, imbibed from his master an emblematical taste; he spent eight years in Italy, hurried back at the death of his mother, and painted that wonder of art the Elevation of the Cross, before he was thirty. It is the perfection of a fearless hand and daring brush, conscious of its principle; and though the sweep of Michel Angelo's contours, applied to butcher's backs and coal-heaver's legs, rather increased their vulgarity than added to their refinement, yet the dashing power of that astonishing picture, in spite of its Flemish, pallid, and ugly wretches for women, renders it the bloom of his powers. Rubens was a man of such general knowledge, that the Marquis of Spinosa said, that painting was his least qualification. He was ambassador to Spain and England, and adorned the banquetting ceiling at Whitehall, the centre portion forming an amazing picture. Educated classically, he carried classical feeling into every thing but his art; and after spouting Virgil with enthusiasm, he turned to his canvass and painted a Flemish butcher with bandy legs (if he happened to have such) for Æneas. How extraordinary it is that, relishing as he did, Homer, Virgil, and Livy, he should give Dutch Helens, Flemish Junos, and German Diomeds, for classic art. His greatest work is the Luxembourg Gallery; and for once he hit a sweet female expression in the mother of Mary de' Medicis, after accouchment. One of his finest pieces, the Rape of Proserpine, is at Blenheim, where the Arethusa, as a water nymph, is putting up her hand, with her back towards you. That a man who could occasionally paint with such delicacy, should so often disgust us with his flabby vulgarity, is not to be accounted for. He painted portrait finely, landscape sweetly, and animals with great power, except the lion, whose straight shaggy mane he always curled like the ancients, and lost its noble look. He was a great man, and painted wherever he went. He was diligent and religious; he rose at four, heard mass, and went to his painting-room, where, with little intermission, he painted till five; he then rode, and returned to his friends, many of them the most celebrated men of the day, who were assembled to meet him at supper; at eleven he retired, and again proceeded to work at day-break. It is interesting to contrast this virtuous course of so great a man, with the vulgar infidelity which alone distinguishes the most incompetent in the art; and it is impossible not to conclude, that those whom God has most endowed with gifts, are the most sensible of their own imperfections. Rubens was thrice married, and educated his children highly; one of them wrote a very learned work, *De lato Clavo*, which shews research and learning.

No where did Rubens shine so effectually as in the Louvre. In all the world, perhaps, there never was such a splendid opportunity for studying to perfection the principles of the great men in the art, as was afforded in the Louvre in its full glory; and injurious as the formation of that collection had proved to the cities of Italy, yet Napoleon gave a dignity and an importance to the art, which it has not since lost, by making the productions of its great men subjects of treaty, and receiving them as equivalent to territory or treasure. There you rushed from the Romans to the Venetians, from the Flemings to the Spaniards, from Titian to Raffaelle, from Rembrandt to Rubens, and settled principles in half an hour, which it took others months, perhaps years, to accomplish. It cannot be denied, that in force of effect, Rubens bore down all opposition, from his breadth, brightness, and depth; and let every painter be assured, that if he keep these three qualities of effect, the leading qualities in the imitation of nature, he will defy rivalship in the contest of exhibition.

Painting.

Rembrandt, with all his magic, painting on too confined a principle, lost in power, and looked spotty and individual. Paul Veronese and Tintoretto had not that solidity, which is the characteristic of Rubens; Titian seemed above contest, and relying on his native majesty of colour, exhibited a senatorial repose, which gave to Rubens a look almost of impertinence; but still you could not keep your eyes off the seducer, and even if you turned your back, you kept peeping over your shoulder. Here all peculiarity suffered. The silvery beauty of Guido looked grey; the correctness of Raffaelle looked hard; Rembrandt failed most by the brightness of Rubens, the magic of Corregio, or the sunny splendour of Titian; and after wandering about for days, you decided that *he* suffered most who had most peculiarity. With all his grossness, want of beauty, and artificial style, Rubens' brightness and breadth carried the day, as far as arresting the eye, and forcing you to look at him, hate as you might his vulgarity, and his Flemish women, and his Flanders breed of horses.

Rembrandt

Rembrandt van Rhyn, was next to Rubens, in point of art, and more than equal to him in originality. Whether in portrait, landscape, or historical pictures large and small, he was like nobody; as wonderful as any, and sometimes superior to all. His bistre-drawings are exquisite, his etchings unrivalled; his colour, light and shadow, and surface, solemn, deep, and without example; but in the naked form, male or female, he was an Esquimaux. His notions of the delicate form of women, would have frightened an Arctic bear. Let the reader fancy a Billingsgate fish-woman, descending to a bath at a moment's notice, with hideous feet, large knees and bony legs, a black eye, and a dirty night-cap,—and he will have a perfect idea of Rembrandt's conception of female beauty. Though his historical pictures are often remarkable for pathos and expression, his characters are sometimes absolutely ridiculous. His Abrahams are Dutch old clothesmen; and yet his Jacob's Dream is sublime beyond expression. Whatever he painted, he enriched; his surface was a mass of genius, and his colour a rainbow, darkened by the gloom of twilight. In portrait, sometimes, his dignity was equal to Titian; but the characters he painted were inferior.

These two wonderful men, each a perfect contrast to the other, revived art; Rubens on the principles of the Venetians, and Rembrandt in defiance of all principles. But the latter sacrificed too much to a peculiarity, and he was punished for it in the Louvre by the side of others.

Vandyke, &c.

Rubens produced Vandyke, Snyders, and Jordaens, and a whole host of pupils. Vandyke had more elegance, but not so much imagination; Jordaens more vulgarity, with equal power. Snyders was a mere animal painter, and he carried the touch necessary to execute the hairy skin of an animal, into every thing he did. Vandyke by his splendid portraits, certainly generated a love of art in England, which has never left us, after the destruction of historical painting at the Reformation.

Teniers, &c.

Rembrandt had pupils, who were by no means equal to himself. David Teniers the elder was a pupil of Rubens. These two extraordinary men were certainly the founders of the Dutch school; and the great principles of their works were carried by David Teniers the younger, Jan Steen, Ostadt, and Cuyp, into smaller and more delicate productions. A man of the highest ambition and noblest views in art can study with the greatest benefit the dead fish and bunches of turnips, servant girls and drunken boors, for beauty of handling and effects in art. He who looks down on the excellencies of the Dutch school, does so from a narrowness of understanding, and not an enlargement of views; and if an historical painter can see nothing to learn in their little beautiful works, he will not learn much from the greater productions of Titian.

Spanish school.

Directly after the Flemish comes the Spanish school, which, not so vulgar as the former, was equally unideal. The Spaniards painted the people about them for all sorts of subjects and all sorts of characters; and they are only more refined than the Flemings because the Spaniards are a more cultivated people. The long possession of the Moors prevented the Spaniards from advancing as soon as Italy. The great schools in Spain have been those of Madrid, Seville, and Valencia. In 1446 Antonio Rincon abandoned the Gothic of the European artists; in 1475 Gallegos was so like Albert Dürer, that he is suspected to have been a pupil; in the sixteenth century riches flowed in, patronage was liberal, and, what is most important of all, genius existed in Spain. Becerra de Baeza, pupil of Michel Angelo, painted in fresco, at Madrid, Salamanca, and Valladolid; and in the Trinità del Monte in Rome, there is also a picture of his. Various painters follow of course in all the schools, till the coming of the real hero of Spanish art.

Velasquez.

Velasquez was born at Seville in 1599. He became a pupil of Herrera, and left Seville in 1522, to seek his fortune in the metropolis; where he succeeded so completely as a portrait painter, that he got to court, and having become acquainted with Rubens, often visited his painting-room. Rubens must have been of the greatest use to him. Velasquez then visited Italy, but could not bear the Roman school after the Venetian. In masterly execution and life he surpassed Rubens and Vandyke. Of all the great painters, he seems to have despised the most the vulgar appetite for what is called *finish*, that is, polished smoothness. Every touch from Velasquez is a *thought* calculated to express the leading points of the *thing* intended to convey it. Masterly beyond description, and delightful beyond belief, he conveyed the impressions of life as exquisitely as if his imitation breathed. But so utterly decayed is the present Spanish school, with its pompous academy, that Spaniards when asked how they can reconcile their hideous polish with the freedom of Velasquez, have answered that *Velasquez was always in a hurry.*

Murillo.

After Velasquez ranks Murillo, a man of a tenderer genius, but equally alive to life. He has the surface of Corregio and colour peculiarly his own; and he was what the Italians call a *Naturaliste*, indeed, the whole school was of that species. Like Rembrandt and Rubens, the heroes of history are always the countrymen of the Spanish painter. The Prodigal Son is one of the finest works in the Duke of Sutherland's collection; it is beautiful in execution, light and shadow, and colour, but Spanish in character and expression. They never got beyond their model or their country; and this may in a great measure be owing to their masters having been Venetians, though Tibaldi and Torrigiano had visited Spain. Murillo was an exquisite painter, and if he had been soundly educated like the Greeks, would have been as refined in character and form as he is now in colour and handling. He first got an insight into painting from Moya, a pupil of Vandyke. Having sold his pictures to hawkers for what they would bring, he saved money and went to Madrid, and, with the frankness of genius, at once introduced himself to Velasquez, who received him like another Raffaelle. After three years of continued kindness, he returned to Seville, founded an Academy, and for his great work of St. Antony at Padua, he received ten thousand reals. It is said that he covered more canvass than any body else; but after the acres of Rubens in the Louvre, that assertion is questionable. Velasquez and Murillo, of course, came like the rest, *before* academies. One now exists in Madrid, and no genius has appeared since its institution. It is quite ridiculous to see the same results all over the world; and it is still more ridiculous, to find the kings of Europe still continuing to found and embellish these useless establishments.

French school.

In France, throughout all the middle ages, the art of design was never extinct, either in mosaic, glass, tapestry, fresco, miniature, or tempera. Though the learned author of the "Discourse Historique" says, that the French were the first who presumed to personify the Almighty in the form of man; yet nothing worth remembering occurred till the death of Leonardo, in the arms of Francis I. in 1518, and the employment of Primaticcio, Rosso, and Nicolo del Abbate. Jean Cousin in 1462, and Vouet in 1582, were the first French painters of any importance in this latter period. Simon Vouet, the younger, was the master of Le Sueur, Le Brun, Mignard, and Dufresnoy; he lived in 1600, and the best period of French art was from that time until 1665, the beginning of the reign of Louis XIV. They, as usual, founded an academy, ten years before Poussin's death; and Coypel, Jouvenet, and Rigaud, were the produce of the institution; whilst Poussin, Le Sueur, and Le Brun, had flourished and obtained their reputation before it was founded. Van Loo and Boucher succeeded Jouvenet and Rigaud, and gave additional evidence of the utter incompetence of the academic system. About 1770, flourished Greuze, who began to evince a better taste, and was persecuted by the Royal Academy for his independence, till the Revolution of 1790 put an end for the time to all imposture. Down went the Royal Academy in an instant; and all the conventional distinctions in art, which are generally the cloak of imbecillity, were fluttered off in the whirlwind. The people, long prevented from seeing fine works in the great galleries, now broke into these galleries with brutal exultation. Bloody and dreadful as were the consequences of the first burst of the French Revolution, one of its most beneficial effects consisted in throwing open all matters of art and science to the people. Naigeon, the conservator of the Luxembourg, said, in 1814, that nothing was opened to the people before the Revolution; and we ourselves in England are now enjoying our Museums, entirely in consequence of the effect produced upon Mr. Fox and the English, who visited Paris in the year 1802, and who were astonished at the noble frankness with which the Louvre was exposed.

The academy being swallowed up in the whirlpool of political revolution, the Institute supplied its place. Napoleon, on becoming first consul, sent immediately for David, who had been a furious republican during "le temps de la terreur;" a man of great talent, but of abominable taste. Napoleon made him his court-painter, and gave such preponderance to his influence, that the detestable style of David became everywhere but in England the style of European art. Gros, Prudhom, Guérin, deviated from the rigidity of David's style. Prudhom was a man of genius. Hideous as was the style of David, in fact painted Roman sculpture, it had some foundation in reason. This was, if possible, to bring the French back to classical art, after the flutter of Boucher, and the pomposity of Coypel; but, like all reformers, he went to excess.

The materials for assisting them are so deficient, that the greatest artists have arrived at any thing like an imitation of nature only by the greatest science and skill. It is much easier to paint a button and a chair, than a human face; therefore the great artists dwelt upon the face with all their dexterity, and touched off the button and chair with less anxiety and care. The French used to say, that *theirs* was the system of the ancient Greeks, and that it was *our* prejudice to disapprove of it. But before we have done, we shall show that it was not the system of the ancient Greeks; and as we pay all due deference to the Italians, Flemings, Dutch, Spaniards, and Greeks, and to their own Poussin and Claude, they have no right to accuse us of prejudice because we disapprove of David. We do not deny David's talent, because it must have required talent to mislead the continent of Europe. In art David's expression was taken from the theatre, and his actions were borrowed from the opera house; his forms were Roman and not Grecian, and his colour was hideous enough to produce ophthalmia. If he and his pictures, with all he ever designed, and all he ever invented, had not appeared in the world, or having appeared, had been utterly rooted out of it, the atmosphere would be purer. He is a plague-spot, a whitened leprosy in painting, that haunts the imagination with disgust. This he had the impudence to say of Rubens. But since the peace, and from the connection with England, a better school of colour has sprung up in France; and La Roche gives evidence of having in some degree got rid of the furniture look of David, though it still poisons a French pencil.

Horace Vernet is a distinguished name; indeed, he may be called the first light-infantry grenadier of European art. He paints a head in five minutes, a whole imperial family in ten minutes, and an historical picture in twenty; and he paints all three with talent and skill. Though the French are not yet *sound* in art, they are the best educated artists in Europe; and if the English would combine their own colour with the careful habits of French early study, and if each school could supply the deficiencies of the other, they would make out a very good school between them.

In thus suffering ourselves to be led away to the present state of the French school, we have omitted to do justice to the great men of former times; Poussin, Sebastian, Bourdon, and Le Sueur. Poussin is the hero of French art. His Death of Germanicus is very fine, as a specimen of history; and his Polyphemus sitting on the top of a mountain, and playing his pipe, with his back towards you, is a pure specimen of the poetic. He studied the ancient Romans so much, that he became Roman in his faces, drapery, and figures; and in his naked forms, the common model is too apparent. His finest works are in England; but though distinguished for expression, there is always an antique heartlessness, as if copied from the masks of an ancient theatre.

Bourdon's Return of the Ark is a high proof of his conception; and Le Sueur's St. Bruno is pure in taste, but bad in colour. The Battles of Alexander by Le Brun show the latter to have been of the family of machinists. His colour is bronzed and disagreeable. Le Brun was a court-favourite, and his Greeks, as well as barbarians, have an air of the opera at Versailles. His composition is artificial; and he is not a fit example for youth. The only man who coloured with exquisite feeling was Watteau, whose touch and delicacy of tint may be studied with great profit by any artist.

In a word, it is extraordinary that the French as a nation, have never been right in art. Poussin was the only man who could have set them right, and they persecuted him so, that he settled in Rome. Claude Lorraine can hardly belong to them; and though Louis Philippe is now employing them by hundreds, nothing very eminent has yet proceeded from such encouragement.

Progress of the Germans.

The Germans are taking higher ground than any other nation, and are making rapid advances, particularly at Munich. They have begun again fresco painting; and the liberality of their king has rendered Munich the most flourishing city in Europe for arts and artists; but as Canova said when he was in England, there is very little grand art left in the world. It is extraordinary to reflect on the little original thinking that is to be found. This was more apparent in the Louvre than any where else; and one could not help being amused at seeing the way in which Rubens, who, like Michel Angelo, is supposed to have never looked out of himself, had plundered the old Gothic painters; the Fall of the Damned, by an old German, being the complete basis of the same subject by Rubens.

When incessant demands are made on the genius of a favourite, every aid to thinking is grasped at and improved. Raffaelle did this; so did Rubens; and even Reynolds used to have portfolios brought him to look over at breakfast, and select what would help him, saying, "It will save me the trouble of thinking." This involves a very serious question in art. The utmost merit that can be allowed is that of *skilful adaptation.* "Nihil tetigit quod non ornavit" may be said of all these; and surely a good thought badly done is justifiable food for a superior mind to render it better.

British school.

We come now to the British School, which, though the last founded in Europe, is inferior to none in variety of power. There is no doubt that the art[1] would have advanced in Britain side by side with the continental nations, if we had continued Catholics; in fact, we were doing so, when Wickliffe's opposition to the Catholic priests roused up the people to hate and detest every thing connected with their system. Painting of course came under this furious denunciation, and through successive ages went on till the period of the Reformation.

Historical notices of British art.

In Edward the Confessor's time, there were executed bas-reliefs as good as any thing done at that time in Europe, and by no means deficient in grace, though disproportioned, and unskilful in composition. In one of these there is a king in bed, and leaning upon his hand; which in an improved style might be made a fine thing. In Alfred's reign and before, York and Canterbury were adorned with pictures and tapestry; and in the tenth century, Ethelrida adorned Ely Cathedral with a series of historical pictures in memory of her famous husband Birthwood. As this is recorded, says Strutt, the practice must have existed before; and that it continued to exist and be the fashion down to the Edwards and Henrys, there is good evidence; for in the time of Henry III. mention is made of the immortal Master Walker's painting in Westminster, the no less renowned John Thornton of Coventry, painter there, and the east window of York.[2] In the reign of Henry VIII. there was a chartered society of painters; and in the seventeenth of Elizabeth it was moved in the House by Sir G. Moore, "that a bill to redress certain grievances in painting be let sleep, and be referred to the Lord Mayor, as it concerned a controversy between *painters and plaisterers*;" and Sir Stephen Jones stood up and desired that the Lord Mayor "might not be troubled, and *it seemed to go against the painters*."

The painters who complained that the plaisterers used their colours, and took the bread out of their mouths, go on to say, that in the nineteenth of Edward IV., that is in 1480, there were orders issued "for the use of *oil* and *size*," and that the "painters' only mixture was *oil* and *size*, which the plaisterers do now usurp and intrude upon." In their petition they observe with the greatest simplicity: "Workmanship and skill is the gift of God, and not one in ten proveth a workman, and that those who cannot attain excellence must live by the baser part of the science." They add that "painting on cloth is *decayed*; that this art is a curious art, and requireth a good eye, and a stedfast hand, which the infirmity of age decayeth, and then *painters go a-begging*;" and then they conclude the petition to the House by this remarkable passage: "*These walls thus curiously painted in former ages the images so perfectly done, do witness our forefathers' care in cherishing this art of painting.*" "This bill," said Sir Stephen Jones, "is very reasonable and fit to pass," and so it did.[3]

The above extract, proves that in Elizabeth's reign the historical attempts were alluded to, *as belonging to former ages*, viz. from the tenth century downwards; that the House of Commons praised the wisdom of those times in cherishing painting; and that this wisdom the Reformation had obviously discarded.

In 1538, Henry issued an order against the use of pictures and statues to impose on the people; yet pictures are called "bokes for unlearned people." In 1542, in his letter to Cranmer, the king tries to restrain the destruction of pictures; but it was too late. In the reign of Edward IV. the Duke of Somerset fined and imprisoned all those who possessed pictures of religious subjects. To such excess had the fury of the people been excited, that the recorder of Salisbury, Mr. Henry Sherfield, was fined L.500, and imprisoned in the Fleet for not breaking a painted window in Salisbury Cathedral. Walpole says that one Bleese was employed at 2s. 6d. a-day to break windows at Croydon; and in Charles I.'s reign it was ordered,[4] that all pictures having the second person of the Trinity should be burnt, and that all pictures having the Virgin should share the same fate. Cromwell stopped this barbarity, and it was owing to the self-will of this extraordinary man that the Cartoons of Raffaelle was bought in for L.300, at the sale of Charles's effects.

Thus it is clear the art was stopped by the Reformation. In St. Stephen's Chapel, before the alterations made some years since, there were figures painted on the walls, as excellent as any figures in the Campo Santo, and perhaps executed about the same period. In Elizabeth's reign, as we have seen, historical art is referred to with sorrow in the House, as a thing past but which had existed; and in the same reign, says Hillier, "men induced by nature," to pursue high art, "have been made poorer, like the most *rare English drawers of story works*." Now, Hillier would not have said this, if it had not been true that the drawers of *story works* were principally *natives*.

In Henry VII.'s time, Torrigiano, the same youth who had felled Michel Angelo to the ground in the gardens of Lorenzo and shattered his nose, was in England, and executed important works. In the time of Henry VIII., commissions for high art being over, Holbein devoted himself to court portrait-painting, though in the city he painted some large pictures. Rubens' and Vandyke's visit excited Dobson, a capital painter of a head; but although Oliver was distinguished as a miniature painter, and although there are designs at Oxford, by English painters, no one genius seemed to arise till after Lely and Kneller had succeeded Vandyke. Cooper was the first English painter employed in foreign courts as a miniature painter. Thornhill, a man of talent,

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[1] It is a curious fact, that the art seems to have been in an advanced state in England, while it is doubtful whether there was a painter in Florence in 1236. In 1250 the authorities in Florence sent for some Greeks because there was no painter; yet at that period in England, and long before, historical painting seemed quite the fashion amongst the upper classes. All the king's rooms, as well as his chapel, were painted. In the 25th of Edward III. in the rolls of the Exchequer, 26th September 1351, there is a charge to "William of Padryngton, for making twenty angels to stand in the tabernacles by task-work, at 6s. 8d. for each image, L.6, 13s. 4d." In 1530, were begun the beautiful pictures and designs in St. Stephen's Chapel; and it is curious to see, in all the accounts, the continual allusions to oil-painting. The artists employed must certainly have been men of distinguished talent, who had the power of ordering inferior artists to assist them. The most celebrated of their number appears to have been Hugh de St. Alban's, who was appointed by the king as his principal painter. The following document, dated 18th March, 1350, contains his appointment. "The king to all and singular, the sheriffs, mayors, bailiffs, officers, and his other lieges, as well within liberties as without, to whom be greeting, Know ye, that we have appointed our beloved Hugh de St. Alban's, master of the painters assigned for the works to be executed in our chapel, at our palace at Westminster, to take and choose as many painters and other workmen as may be required for performing those works, in any places where it may seem expedient, either within liberties or without, in the counties of Kent, Middlesex, Essex, Surrey, and Sussex, and to cause those workmen to come to our palace aforesaid, there to remain in our service, at our wages, as long as it may be necessary. And therefore we command you to be counselling and assisting this Hugh, and completing what has been stated, as often and in such manner as the said Hugh may require." (See Britton's *West. Pal.* p. 170.) The illustrious Hugh seems to have been a designer; for in the books, (25 Edward III. April 30,) is the following entry, "to H. de St. Albans, ordering or *designing* the drawings for the painters, one day, 1s."

[2] See Carter's *Etchings*.

[3] See Sir W. Monson's *Account of the Acts of Elizabeth*, 1632, British Museum.

[4] See Journals of the House, 23d July 1645.

and a member of the House, forms the link between one race and another; and then sprung up Hogarth, Gainsborough, Wilson, West, and Barry. As usual, when Reynolds and Hogarth had for ever rescued Britain from all doubt as to her genius, without an academy of any description, a royal academy was founded to produce more genius, just as had been done all over Europe; and no man equal to Reynolds and Hogarth has since appeared.[1] After the academy was founded at Milan by Leonardo, no genius like his appeared. After that of St. Luke was founded at Rome, Raffaelle and all being dead, no one came forth. After an academy had been founded at Parma, Corregio being gone, nobody appeared. After a national academy was founded at Venice, and royally endowed, genius fled. The same thing happened in Ferrara, Modena, Florence, and Naples; and also in France, Spain, and England. Need further evidence be sought of the uselessness of such institutions?

The Academy.

In 1711, there existed a school, of which Kneller was the head, whilst Vertue the engraver drew in it. After 1724, Sir James Thornhill opened a school in his own home Covent Garden, and so did the Duke of Richmond at Whitehall Privy Gardens. Sir James proposed to Lord Halifax to found a royal academy, but without success. At Sir James' death, the school was broken up, and the artists were again left without instruction; when, for the purpose of studying the living model, they hired a room in Greyhound Court, Arundel Street, and Michael Moses was the conductor of it. Here they were visited by Hogarth, who was so well pleased, that a union of the whole body took place, and they removed to Peter's Court, St. Martin's Lane. The number of members amounted to a hundred and forty-one, each paying an annual subscription. There was at the time a great deal of happy fellowship amongst the artists. Reynolds, who was a member, with Hogarth and others, adorned the Foundling Hospital; and the public were so interested, that the society thought they might venture on a charter, which was obtained, and there was established by law a government of twenty-four directors, annually elected, including the president, by the whole body and out of it. An united exhibition having begun, (the constant source of irritation, for every man cannot have his works in the best places,) squabbles arose; and the directors finding the benefit of being able to hang their own works and those of their friends in the best situations, intrigued to keep their places another year. This was foolishly granted; and every subsequent year finding themselves becoming a match for the constituency, they kept their places for eight years, in defiance of law; so that at last it was found that the men elected to preserve order and law, had been the grossest violators of both. With the feelings of independent freemen, the constituencies resolved to endure this no longer; when, to prevent collision, it was agreed to refer the point to the Attorney-General, De Grey, both parties pledging themselves to abide by his decision. De Grey gave it against the directors, and these honourable men then refused to keep their word. The constituency met, and violently expelled sixteen of them; but before resigning, these gentlemen met secretly, and fearing exposure, tore out and destroyed the minutes from the 19th November 1764, to the 11th March 1765, and from the 17th of June 1765, to the 21st of March 1766. They then went to the king, George III., whom they persuaded that the chartered body was republican; and that there was no hope unless a royal academy was founded, with the number of members and voters limited to forty. The king, without inquiry, foolishly yielded to their cunning suggestions, and founded an academy with forty members; the other eight directors resigned directly, and the whole twenty-four were made R.A's. Thus by this limited number were framed the present exclusive law and constitution, and all the obnoxious regulations passed, which had been checked by the sense of a constituency; and thus the art of England received a blow more fatal than at the Reformation. The weakness of the nation has been gratified to an excess by this interested assembly, to the ruin of their taste and judgment; high art has gone back, and is going back further every year, by the struggles of these men to keep up their monopoly, in defiance of the increasing intelligence of the people, which they fear, and which will yet be their utter destruction. In this affair Reynolds behaved with great meanness. He promised to stand by the constituency; yielded at the offer of a knighthood; was afterwards justly punished, by being compelled to resign; and foolishly complained of ingratitude which he had deserved.

In order that the state of art in Great Britain may be rightly understood, this authentic detail, taken from pamphlets published at the time, especially that of Sir Robert Strange,[2] has been thought necessary; and it will not appear tedious, if it be considered that, for the sake of the art of our own country, it is but just that particulars should be ascertained. The effect of the academy has been pernicious. Imitating the example, all the eminent provincial towns have established exhibitions instead of schools; and every year the annual exhibition in the metropolis is repeated in the provinces, with but little addition to that which proved unsaleable in the London show. Hogarth opposed such a conclusion, and from the beginning predicted its effect, which has happened to the very letter; and when Reynolds began to perceive the truth, he acknowledged his error, and said to Sir George Beaumont, that "a party was gaining ground which would ruin the art."[3] If the detail of every other academy in Europe could be thus laid open, the same intrigues, the same despotism, the same injustice, and the same want of principle would be found at the bottom; and Europe would no longer wonder that academies never have produced a Raffaelle.

Reynolds.

The honest and straight forward constituency being thus left as it were unprotected by the king, it was soon deserted by the nobility and the public, and shortly escaped notice altogether; though such a man as Hogarth had improved his knowledge by drawing in its schools. The literary splendour with which Reynolds was surrounded, gave a glory to the Academy which it has not yet lost; and the genius of Reynolds spread a halo around it, which the artists still fancy they see, though it vanished the moment he expired. Reynolds was really a great artist; gorgeous in tone and colour, unimpeachable in composition, deep in light and shadow, beautiful in character, and the purest painter of children and women that ever lived in the art, Greek or Italian. His ignorance belonged to the period; his beauties were entirely his own; and though he overrated Michel Angelo, and has done injury to taste, by his sincere conviction that he was right, yet had he lived to see the Theseus or Ilyssus, he would have been equally candid in saying he was in error. Lord Heathfield is a portrait that need not fear any work of Titian's for men, and Mrs. Parker, a tender, sweet picture of a woman, was never equalled in sentiment or delicacy by any work of the Venetian and Roman schools. Where were children ever so completely hit as in the Infant Academy? who surpassed the propriety of his back-grounds as well as their splendour? His eye, or rather his organ for colour, was exquisite; nor is there in the whole of his works a heated and offensive tint. He did not combine essential detail and breadth so beautifully as

[1] Wilkie was not produced at an academy, but at Graham's school, Edinburgh. Now this school is an academy with all its pride, and nobody will come of it.

[2] See Sir Robert Strange's pamphlet, and another published in the year 1771, by Dixwell, St. Martin's Lane, entitled "On the Conduct of the Royal Academicians," in the British Museum.

[3] This was told the author by Sir George; and has since been confirmed by his pamphlet, "Concise Vindication," &c. in British Museum.

Titian; but place one of his finest portraits by the side of any picture of Titian's, see them at the proper distance, and Reynolds would keep his station. Here, however, the praise must stop. Reynolds could have no more painted Pietro Martyre than he could have revived the martyr after he was dead. He was not so great a man as Titian, because he did not like him remedy his ignorance, when he found it out at a much earlier age. He was always talking of what he would do if he began the world again. Sir Joshua loved society; he was the deity of his coterie; he liked a glass of wine and a game at whist; and he never lost his temper because he was successful in the world, but the first time he was thwarted he got in a passion. Reynolds was a great genius in painting, but not a great man. He raised English art from the dust, and gave English artists an *à-plomb* in society which they never had before, and he first reduced the art to something like system by his discourses; but not having moral courage to resist the formation of an academy, which *he* could have done by his influence and his genius, he compromised the art, and was indirectly the means of throwing it off its balance, which it will yet take half a century more to remedy, as Hogarth predicted.

Hogarth.

As an inventor, Hogarth is by far the greatest of the British school; although in aim and object, colour, surface, and all the requisites of a great painter, infinitely below Reynolds. It would be useless to detail the perfections of a man so admired all over the earth, and who will only cease to be a delight with its existence. It is astonishing how hereditary is the hatred of academies. The painters in revenge for Hogarth's opposition, swore that he was no painter, and swear so to this hour. The absurdity of this criticism can be proved by the Marriage à la Mode, whilst the picture of the husband and wife after a rout, is as beautifully touched as any in that class of art can be. He has not the clearness of Teniers, nor the sharpness of Wilkie; his touch is blunt, and his colour deficient in richness; but you feel not the want whilst looking at him; and although his expression is often caricature, yet in the above picture it is perfection. Hogarth unfortunately believed himself infallible; but his wretched beauty of Drury Lane for Pharaoh's daughter at the Foundling, his miserable Sigismunda, and his Paul before Felix, we hope convinced him of his forte. If he was *serious* in these pictures, which we very much doubt, he deserved a strait waistcoat and a low diet as the only treatment for his hallucination.

Gainsborough.

Gainsborough was another painter of great genius in portrait and landscape; but Wilson was a greater. His touch and feeling were comprehensive, though too abstracted for the vulgar, who always like polish and to put up their fingers. He used to say to Sir George Beaumont, "When somebody is dead somebody's pictures will sell better." From neglect he got into foolish habits of drinking and died librarian to the academy. A miserable dauber called Lambert was the fashion, and his character as a landscape painter was hit by poor Wilson. He said "his trees and foliage were eggs and spinach, and nothing more;" yet Lambert got hundreds when Wilson could hardly get shillings. But where are now the immortal Lambert's works? Making fire-screens for garrets, whilst "*somebody's* pictures" adorn the houses of the great. Gainsborough was a great portrait painter and ran Reynold's hard. West's Wolf and La Hogue are the triumph's of his talent; but his great sacred subjects are inferior works. The writer of this observed to Canova in England, "Au moins, il compose bien." "Monsieur," replied the Italian, "il ne compose pas; il met des figures en groupe." He was a skilful machinist; and though there are bits of colour in his small works, rich and harmonious, his portraits are detestable, his handling unfeeling, his drawing meagre and common. He was deeply versed in nothing, though possessing great acquired knowledge of his art without being an educated man. With respect to his being the greatest man since the Caracci, with Rembrandt, Rubens, Vandyke, and Dominichino, Guido, and Guercino since, or a little after, the idea is ridiculous and absurd. The king hated Reynolds on account of his devotion to Burke and Fox, and puffed West from sheer irritability. The king said to Hopner, "Why does Reynold paint his trees *red* and *yellow?* who ever saw trees that colour?" Hopner, who said what he pleased, replied, "Then your majesty never saw trees in autumn."

Romney.

Romney, a second-rate man, had great patronage, whilst Barry, a man of great grasp of mind, had none whatever. Barry joined the Academy to oblige Reynolds, against his own convictions; was soon at issue with its selfish monopoly; opposed it; urged the propriety of devoting a portion of its funds to establish a school of colour; exasperated the intriguers by his fearless attacks; and was expelled of course as an obnoxious man, the king having been persuaded to sanction it, under the deadly hint that Barry was a radical. Barry was the protégé of Burke, and his Adelphi pictures, shewing the progress of society, though deficient in drawing, colour, and delicacy of touch, were the first work in England on the comprehensive principle of the ancients. Having neglected Burke's repeated entreaties to dissect, he suffered the consequence. His forms at the Adelphi are such as can be got by general drawings from the antique, but there is no refined knowledge of construction in them.

Barry.

As a man of genius, however, Barry is not to be compared to Henry Fuzeli, the friend of Reynolds and Lavater, and one of the most distinguished and accomplished men of his time. Fuzeli was undoubtedly the greatest genius of that day. His Milton gallery shewed a range of imagination equal to the poet's; his Satan bridging Chaos, his Uriel watching Satan, his Shepherd's Dream, his Fairies from Shakespeare, and his Ghost in Hamlet, announce him as having conceived, like Theon, φανταστιας, and as being the greatest inventor in art since Julio Romano. But in the modes of conveying his thoughts by form, colour, light, and shadow, and above all, nature, he was a monster in design; his women are all strumpets, and his men all banditti, with the action of galvanized frogs, the dress of montebanks, and the hue of pestilential putridity. No man had the power like Fuzeli of rousing the dormant spirit of youth; and there issued from his inspirations a nucleus of painters, who have been the firmest supporters of the British school.

Fuzeli.

But Fuzeli, as a painter, must be a warning to all. Had he taken the trouble to convey his thoughts like the great masters, his pictures would have risen as time advanced; yet as time advances, his pictures, from having no hold on our feelings like the simplicity of nature, must sink. His conceptions however poetical, are not enough to satisfy the mind in an art, the elements of which are laid in lovely nature; and great as his genius was in fancy and conception, inventor as he was in art of fairies and ghosts, he will never be an object to imitate, but always to avoid by young men, who are more likely to lay hold of his defects than his beauties. The finest conception of a ghost that was ever painted, was the Ghost in Hamlet on the battlements. There it quivered with martial stride, pointing to a place of meeting with Hamlet; and round its vizored head was a halo of light that looked sulphureous, and made one feel as if one actually smelt hell, burning, cindery, and suffocating. The dim moon glittered behind; the sea roared in the distance, as if agitated by the presence of a supernatural spirit; and the ghost looked at Hamlet, with eyes that glared like the light in the eyes of a lion, which is savagely growling over his bloody food. But still it was a German ghost, and not the ghost of Shakespeare. There was nothing in it to touch human sympathies combined with the infernal; there was nothing at all of "his sable, silvered beard," or his countenance more "in sorrow than in anger;" it was a fierce, demoniacal, armed fiend reeking from hell, who had not yet expiated "the crimes done in his days of nature," to qualify him for heaven. His next finest works were the two fairy pictures in the Shakespeare gallery, some diving into harebells, some sailing in Bottom's shoe; but beautiful as they were, indeed the only fairies ever painted, still your heart longed for nature in colour, form, action, and expression. Such an union had the Greeks, and no art in the world will be perfect until it appears again. These pictures are evidences of the highest conception of the fanciful and supernatural. His Lazar House is an evidence of his power of pathos; his Uriel and Satan of the poetical; his Puck putting on a girdle, of the humorous and mischievous. But when Fuzeli attempted the domestic, as in the illustrations of Cowper, his total want of nature stares one in the face, like the eyes of his own ghosts. Never were the consequences of disdaining the daily life before your eyes, or of affecting to be above it, so fatally developed as in this series of design; though in comparing with him another eminent artist, namely, Stothard, who, in sweetness and innocence, was his decided superior, Fuzeli surpassed him in elevation and reach of mind. In the pictures of Stothard, who painted equally well without life before him, there is not the same extravagance, yet there is almost equal want of nature in another way. Flaxman, Stothard, and Fuzeli, are the three legitimate designers of our school, and yet not one of them was perfect master of the figure.

Flaxman.

Flaxman's designs from the Iliad and the Greek tragedies are his finest works; and when first they appeared in Italy, they were denied to be the invention of an Englishman, as it was supposed to be impossible that any Englishman could have an imagination. But yet of some of these designs it really may be said, "Il n'y a qu'un pas du sublime au ridicule." It is extremely difficult to say whether they are in the highest degree sublime or extremely absurd. In all attempts to express the passions, you will perceive extravagance; but in comparing him with Canova, in this part of the art, Canova must yield the palm as much as Flaxman was inferior in the perfection of working up a single and beautiful figure. Though this eminent man talks pompously of Greek form and anatomical knowledge, he in reality knew very little of either; and though there is a great deal of useful matter of fact in his lectures, yet on the whole they display a wretched poverty of thinking. His book of Anatomy for students is not deep enough on the separation of muscle, bone, and tendon, and can help a young man a very little way to correct notions. The value of Fuzeli's and Opie's lectures in comparison with Flaxman's or Barry's is evident; and the superiority of Reynolds to all, except Fuzeli in his lecture on Greek art, needs not to be dwelt on.

Stothard.

Stothard, as an inventor in composition, was equal to all, but as a painter, certainly inferior to all. In fact he could not paint; he had no identity of imitation; he did not and could not tell a story by human passions; and his style of design showed great ignorance of the constituent parts of the figure. But there was a beautiful and angelic spirit that breathed on every thing he did. He seems in early life to have dreamed of an angel, and to have passed the remainder of his days in trying to endow every figure he designed, with something of the sweetness that he had seen in his sleep. Peace to his mild and tender spirit. It was impossible to be in Stothard's painting-room for ten minutes without being influenced by his angelic mind. He seemed to us always as if he had been born in the wrong planet. He had a son whose etchings from our ancient tombs are an honour to the country. He fell from a great height, in pursuing his designs from some tomb in a country church, and was killed. This ill-fated artist was in every respect worthy of his father.

West.

Never were there four men so essentially different as West, Fuzeli, Flaxman, and Stothard. Fuzeli was undoubtedly the man of the largest capacity and the most acquired knowledge; West was an eminent artist in the second rank; Flaxman and Stothard were purer designers than either; Barry and Reynolds were before all the others. In Barry's Adelphi there is a grasp of mind, as Johnson said; yet as a painter he was inferior to all. Though Fuzeli had more imagination and conception than Reynolds, though West put things together with more facility, and Flaxman and Stothard did what Reynolds could not do; yet as a sound, great, and practical artist, in which all the others were deficient, Reynold's must be considered the head of the British school as a painter and handler of his brush.

Opie, Northcote, Wilkie.

Opie must not be omitted, nor Northcote his imitator and contemporary, both of them men of talent. Opie, a man of great and powerful genius, issued from Cornwall at once on the town. Northcote was six years with Reynolds; and his Arthur and Hubert, and Children in the Tower, are fair specimens of his talents. He was a malicious man, and tried to injure his greatest protector, Reynolds, and Dr. Mudge who introduced him, by allowing Hazlitt to print his (Northcote's) Conversations. There never was a deeper scheme for malignant defamation. Northcote always said that *he* did not print them, and Hazlitt that *he* did not talk them; and each vented his spite on a mutual friend, and shifted the blame to the other. Reynolds was succeeded by West, and the art sunk to the lowest depth, containing only Sir Joshua's humble imitators, when a genius broke forth, David Wilkie, who rendered our domestic school, the first in Europe; and the feeling for art has been rapidly advancing amongst the people ever since. This many circumstances unite to prove.

Parliamentary inquiry.

In consequence of the perpetual complaints from the great body of artists, the government granted a committee in 1836, to examine the cause of the superiority of France in manufacturing design, as well as the condition of high art, and to ascertain if the accusations against the Royal Academy were true or false. Never in the world were the consequences of a monopoly on the perceptions of respectable men so ludicrously developed. The president and body first denied the right of the House of Commons to examine them at all; and when the persuasions of their friends showed them their folly, their appearance before the committee presented a scene never to be forgotten in the history of English painting. On all questions of finance, they proved satisfactorily the honour of their transactions; but on all questions of art more was proved against them than ever had been suspected.[1] The resignation of Reynolds, and the expulsion of Barry; the loss of a million of money to the art on the Waterloo monument, in consequence of their not replying to Lord Castlereagh's committee; their refusal to let the artists also support their exhibition, and have the same opportunities of fitting their works for the public as at the British Gallery; and, to crown all, their rendering the school of design lately established of no avail to the mechanic, by establishing a law, that the study of the figure is not necessary for his education, though it was proved that this study at the Lyons academy for mechanics, was the real cause of their superiority to us; are such indisputable evidence against their protestations of sincerity, that it has rendered the nobility and the nation more than suspicious of the truth of all the accusations which have been made against them.

Scottish art.

In Scotland the art is in a promising condition, and the Scottish school in purer taste than the English. Living as

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[1] See *Report on Arts and Manufactures.* In this Report the important subjects of Art and Manufacture are both considered; and no one, with any pretensions to taste, should be without it.

Painting.

the artists do, in the most magnificent city in Europe, surrounded by a country pregnant with historical recollections, and guided by their own shrewd understandings, the school in Edinburgh will, before many years, take a very high rank in the art. But there is some cause to apprehend that it will be checked at its most critical period, from the usual cause, the foundation of the old curse of Europe, an academy. After having produced Runciman, Raeburn, Wilkie, and the other eminent men Scotland can boast of in art, they have been persuaded to found conventional distinctions, in favour of a select few; and, as elsewhere, the result will be the same. No Wilkie, no Runciman, no Raeburn will come from it; for the best men they now possess were eminent before it was thought of. The art has no business with any aristocracy of talent. Conventional distinctions, which are not hereditary, are laughable and absurd; and distinctions which are, ought to be reserved for high descent, heroic actions, landed property, or vast political genius. Such an aristocracy produces heart-burnings and injustice; for it places power in the hands of men, who are not amenable to justice for tyranny, and who cannot be reached by law, for calumny or insinuation. "Of all hatreds," said the *Edinburgh Review*, "there are none to equal the hatreds weak men in power bear to the man of genius without it." It is a curious evidence of the sagacity of the Scotch, that whilst the English portrait painters, since the death of Reynolds, were all placing kings and queens on their toes, from sheer ignorance of perspective, Raeburn, Wilkie, and Gordon have never made that mistake.

In a word, it is our decided and unprejudiced conviction, that the genius of the British people, will never have fair play or be soundly advanced, till the Royal Academy is removed, or effectually remodelled; and this will be effected either by the positive interference of the queen or the government, or by the rapidly increasing knowledge of the people. If the capital and the provinces were freed from the predominence of those men; if the honours were abolished and the constituencies restored; if the whole national galleries were turned into a great school, with branch schools in the great towns; if the Cartoons were removed to London for the occasional sight of the people, as they might be inclined to drop in; and if a Native Gallery were arranged for the best productions to be purchased as they appeared, and the House of Lords adorned with a series of grand works referring to the British constitution; then would the government do a real good to taste, refined pleasures, and design for manufactures, such as would entitle them to the everlasting gratitude of the nation.

On the other hand, if all the ancient boroughs of the land have been obliged to bend to the call for reform; if the crown itself has been obliged to yield up the old House of Commons; if the salaries of our great officers of state have been cut down without complaint; if pensions bestowed equally for merit or for vice, are to be rigorously sifted; if the queen herself has been obliged to permit her expenditure to be questioned; are a set of men without a lease of their House, or charter for their existence, without any one legal claim to be considered as a constitutional body—are *they* alone to brave the Commons and the Lords, are *they* alone to defy and deny reformation, taking their stand upon their utter insignificance? If so, it will be an anomaly in the character of the British Legislature, which, in after times, will only be remembered as a proof of imbecility and folly, if not of something still worse than either.

General deductions.

We have now gone through the great leading schools of Italy, France, Germany, Flanders, Holland, Spain, and Britain, and we have taken those names only, which may be considered as leading an epoch; so that, in such a system, many eminent men must of necessity have been omitted. From the Petersburg, Copenhagen, Berlin, or Stockholm academies, no great genius except Thorwaldsen has yet appeared.

Was Italian art equal to Greek art? Certainly not. In the finest Italian there is a want of beauty in form and face, which Greek art could only supply. Poussin said, that Raffaelle was an angel in comparison with the moderns, but in comparison with the ancients he was an ass. Though this is vulgar, it is in our opinion true. The ancients combined the Venetian and Roman schools; they considered form, colour, light and shadow, surface, expression, and execution, as all equally component parts of imitation, and all necessary to perfect that imitation which was to be employed as an instrument to convey thought. They combined the drawing and the colouring of the two great Italian schools; as these illustrious schools tried to do when they found out their error, in pursuing one at the expense of the other.

Reynolds, from the defective practice of each school, laid it down that colour was incompatible with high art; and he also laid it down that the ancients could not be great painters in a *whole*, though they might be in a *solo*, from the pictures on the walls of Pompeii. We do not wonder at any man so concluding before the Elgin marbles arrived; but we do marvel at Reynolds taking the works in the private rooms of a provincial Roman city as justifiable grounds on which to estimate the extent of genius in Greek art at its finest period, five hundred years before. But after all, what are the pictures of Pompeii? Very probably the designs in Pompeii would rank about as high in ancient art, as the designs of our paper-stainers in Bond Street would in British art. The pictures at Pompeii are no more criteria of what the art of Apelles and Polygnotus really was, than any sculpture dug up there would be a criterion of what the art of Phidias was. Reynolds undervalues contemporary praise; but Quintilian, Cicero, Horace, Juvenal, Strabo, Polybius, and Pausanias, Valerius Maximus, Ælian, and Pliny, were not contemporary; and, therefore, the praises of Aristotle or of Plato who were, justify the enthusiasm of those who were not.

Since the works of Phidias arrived in England, we have positive evidence that the Greeks knew the great principles of composition and grouping, as applied to painting; because the metopes are instances of arrangement of line, that will do exactly in a picture, if the Laocoon had not shown it before. Having now seen the Elgin marbles, which the Greeks estimated as their finest work, and having found all the enthusiasm of the ancients more than borne out, have we not a justifiable ground to argue from what we *do* see in one art, that what we do *not* see in another was equally excellent? Will any man, after seeing the Theseus and Ilyssus, doubt that the ivory Minerva and Olympian Jupiter were equally, if not more beautiful? Why should the ancient critics have faith placed in all their decisions except those on painting? Why should they lose their perspicacity of understanding only when they talked of this art? After Aristotle and Plato had admired the Minerva inside the Parthenon and the sculpture outside, they might admire the pictures; and nobody will deny them the power of making comparisons. Had the Elgin marbles and the old antique never been seen, would not the same sophistry have been put forth to question the merit of their sculpture as well as to deny that of their painting? "Nothing can be more perfect than Phidias," says Cicero. "You cannot praise him enough," exclaims Pliny. "He made gods better than men," says Quintilian. "He was skilful in beauty," says Plato. You believe all this, because you cannot contradict it; but the moment Quintilian says, "Zeuxis discovered light and shade; Parrhasius was exquisite for subtlety of line; Apelles for grace; Theon for poetical conceptions, (φαντασιας); Pamphilus for mathematical principle; Polygnotus for simplicity of epic arrangement in colour and form; Protogenes for finish;"—when Pliny commends Aristides for expression, and Amphion for composition, and speaks of the grand assemblage of the gods by Zeuxis, as well as the single figures of Apelles, Reynolds replies, "Admiration often proceeds from ignorance of higher excellence, I will not believe contemporaneous praise." We answer, that admiration oftener proceeds from knowledge of superior excellence; that the most enthusiastic admirers of Greek painting were not contemporary; and that Reynolds' conclusions against Greek art are founded upon data which are altogether erroneous.

Taking the Elgin marbles as a standard, we cannot but suppose that the finest great works of Greek art had the finest drawing, the most wonderful knowledge of form, the finest grouping, and the finest expression. To this may be added, colour from Pliny, light and shadow from Quintilian; perspective from Vitruvius; fore-shortening, dwelling on the leading points, like Vandyke, and touching off the inferior parts from Plutarch; and, what was never suspected, execution with the brush from Horace, on the leading principles of the Venetians. The French used to affirm, that David's principle was the same as that of the Greeks, namely, obtruding on the attention all the superior parts, and neglecting the inferior ones. In Plutarch's life of Alexander, at the very beginning, he describes to his readers his plan of writing his lives, and concludes with this extraordinary passage: "Like painters that paint portraits, who dwell on the face, caring little about the remaining parts."[1] His meaning is, that he would, like painters, dwell upon the leading points in the history of great men and lightly touch off the inferior parts. Could he have made such an allusion for the general reader, if this had not been the practice of the great Greek painters? Again, Horace says in the art of poetry,

> Ut pictura poesis erit; quæ si *propius* stes,
> Te capiat magis; quædam si *longius* abstes.

That is, some pictures are painted for a close, others for a distant inspection. The former, of course, are wrought up; but in the latter, the leading points are seized by a touch, leaving the atmosphere to unite. As to mere handling of the brush, this is conclusive, and shows that it was done on the same system as by Titian, Tintoretto, and Velasquez. Reynolds has quoted Pliny's description of glazing, that is, spreading a thin transparent tint over the crude colours to bring them into harmony, which was the practice of the Venetians. Another passage completes the conviction: "Adjectus est *splendor*, alius hic quam lumen, quem quia inter hoc et umbram esset, appellaverunt *tonon*." (Lib. xxxv. c. 5.) "Now was added *splendor*, a different thing from light, and which splendor, because it was between light and dark, was called *tone*." To the mind of an artist this is exquisite in distinction; first, the colours on the tablet were fresh, unmixed, and raw; then was spread over a transparent glaze to take off the crudeness; then this crudeness being reduced, it was called *splendor*, glowing, rich, and deep, but different from *light*, which is cold and white; and this splendor the Greeks called *tone*, as both the Venetians and the British denominate it. But the circumstance of tone being the characteristic of any school, is proof of an age for colour.

As to their perspective, let any man consult Vitruvius, (lib. vii.). Agatharcus composed a treatise on the subject; and from this hint, Democritus and Anaxagoras wrote on perspective, explaining in what manner we should, in appearances agreeable to nature, from a *central point* make the lines to correspond with the eye and the direction of the visual rays, and render the scene a true representation of buildings, that those objects which are drawn on a perpendicular plane, may appear some retiring from the eye, and some advancing towards it. From a passage in Plato, it is clear, that the Greeks carried the illusions of theatrical perspective to a much greater extent than, in consequence of some bad landscape discovered in Herculanum, has been supposed."[2] That they foreshortened is clear, from Pliny's description of a bull coming out of a picture frontways.

The inferences to be drawn from all this, are, first, from Plutarch and Horace, that the Greeks had execution like Titian and Vandyke; secondly, from Pliny, that they must have had fine colour, (lib. xxxv.); thirdly, from Quintilian, that the principles of light and shadow were understood, (lib. xii.); fourthly, from Vitruvius, (lib. vii.), that they had sufficient perspective to make objects recede and advance; and fifthly, from the Elgin marbles, executed by and in the school of Phidias, who was first a painter, that they had expression, form, and composition. If the three most important can be proved, as they can, and colour, light and shadow, and execution, more than inferred; what right has an eminent English portrait-painter, grossly deficient as a painter of high art, to assert, that they could not be great in extensive compositions, because the painted walls of a provincial city gave no evidence of such excellence in their private houses? forgetting that these were executed five hundred years after the eras of Greek perfection, when Greece was a Roman province, when her cities had been sacked, and her art was talked of as a wonder that had passed away.

Conclusion.

The principle laid down for high art has been, that the lower addresses the eye and the higher the mind, and that the union of the two was incompatible; whereas, the true principle surely is, that both styles address the mind through the eye, but in different ways; the lower walk making the imitation of the actual substance the great object of pleasure only; and the higher walk making imitation the means of conveying a beautiful thought, a fine expression, or a grand form with greater power. The imitation though more abstracted must not be less real or effective. Sir Joshua Reynolds affirmed, that the look of truth which fine colour, light and shadow, and reality gave, distracted the eye from the poetry of the conception or the depth of the expression. But it may be maintained, that in an art, the elements of which are laid in imitation, the beauty of an expression, the grace of a motion, and the sublimity of a conception, will be *increased* in proportion to the look of *reality* in the objects; and the practice of all the great Greek painters, and of Raffaelle and Titian in their latter works, (the Transfiguration, and Pietro Martyre), proves that they had come to the same conclusions. Yet Reynolds, with his usual sagacious policy, appears to waver lest he should be wrong. "There is no reason," says he, "why the great painters might not have availed themselves with caution and selection of many excellencies in the Venetian, Flemish, and Dutch schools; there are some not in contradiction to any style, a happy disposition of light and shade, breadth in masses of colour, the union of these with their grounds, and the harmony arising from a due mixture of hot and cold tints, with many other excellencies which would surely not counteract the grand style." And then he concludes that "a subdued attention to these excellencies must be added to complete a perfect painter." This is all that is contended for. So far from these excellencies being incompatible with grandeur of style, they are essential to it, they are the elements and the basis of it, they cannot be left out, or if they are, the style is deficient, absurd, and not founded in nature. There is not the least doubt that the Greek painters considered the power of imitating natural objects by colour, and light and shadow, as necessary and requisite in preparatory study as drawing or composition; and the greatest painters in the grand style in ancient Greece, were

[1] —— ὥσπερ οὖν ὁι ζωγραφοι τας ὁμοιότητας ἀπο του προσωπου, ἀναλαμβανουσιν, ἐλαχιστα των λοιπῶν μερων φροντιζοντες. ΑΛΕΞΑΝΔΡΟΣ.

[2] *Theatre of the Greeks*, p. 262, 3d edition, Cambridge.

just as capable of imitating still life as the possessors of it now.

It may, therefore, be fairly deduced, that the Greeks possessed all parts of the art, and none particularly to the exclusion of others; that, therefore, all parts of the art, in due subordination, may be considered as essential to an artist of the highest walk, as also in the more humble department; and that the system of Reynolds, which excludes identity and power of reality from judicious imitation of the objects painted, combining colour and light and shadow, as well as expression and form, is *false*, and should be exploded from all systems where art is considered as a matter of importance to the dignity or glory of a nation.

(Q. Q. Q. Q.)

HOUSE-PAINTING.—In a country with a climate like that of Great Britain, house-painting is an art of much importance, as being conducive to the durability and comfort of our dwelling-houses; and in every country it is an art, which, though somewhat mechanical, may be made to approximate to those of a higher and more intellectual nature. The house-painter, therefore, ought to make himself thoroughly acquainted, not only with the mechanical department of his business, but likewise with the rules by which high art is governed, especially those of harmonious colouring. By such means he will, in the first place, understand the best methods of rendering his work capable of resisting for many years the effects of a changeable climate and humid atmosphere; and, secondly, he will be enabled to render even his plainest work pleasing to the eye of the intelligent and tasteful. It is further necessary that he should make himself acquainted with the various styles of ornament, not only in painting, but in architecture, and also with such of the ornamental works of the great masters of antiquity as are still in existence.

For nearly a century house-painting in this country was in the most degraded state; so much so, that when any thing beyond the plainest style of work was required, artists were brought from France to execute it; and specimens of their skill may still be found in many of the mansions of our nobility and gentry. Within these fifteen or twenty years, however, great improvements have been made. The handicraft department has not only become equal, but it is believed, superior to that of any other country, especially in the imitations of the finer kinds of woods and marbles; whilst attention to the scientific part of the art, if it may be so called, is rapidly becoming more general in practice.

We shall, in the first place, give a short account of the plainest branch of house-painting.

It is well known that the ceilings and walls of apartments in dwelling-houses and other buildings of this country are now almost uniformly finished in plaster; and the nature and properties of this composition are also well known. One of these properties is its power of absorbing moisture; consequently, when an apartment is left for any length of time without the benefit of a fire, or heated air supplied by other means, the plaster will continue to absorb a portion of the humidity with which the atmosphere is generally loaded; and this absorption will not only render the room unwholesome, but will tend to impair the durability of the plaster itself. The first object, therefore, in painting a house, is to render the interior walls impervious to this absorption; and for this purpose the house-painter provides various materials.

These are, white lead, ground in refined oil to the consistency of a thick paste, which operation is now performed by machinery on the premises of the original manufacturer, instead of being done by a clumsy hand-mill as formerly in the painter's shop; linseed oil, spirits of turpentine, litharge, sugar of lead, japanners' gold size, ochre, venetian red, lamp black, indian red, Turkey and English umber, terra de Siena, red lead, Prussian blue, orange lead, chrome yellow, vermillion, lake, and other pigments. But white lead is the material of the greatest importance, as it is the principal ingredient in all ordinary colours used in house-painting; indeed, it generally constitutes nine-tenths of the composition, and consequently forms the main body of the paint. The quality of this article is therefore of the greatest importance, as upon it depends almost entirely the durability of the work; yet it is of all the painter's materials the most difficult to get free of adulteration. There are three qualities of this article manufactured, the prices of which vary, according to that of pig lead, from about 27s. to 40s. per cwt. But this difference in the price of white lead is trivial in comparison with the mode in which it is sometimes adulterated. This is done by the introduction of fine whiting ground in oil, in the same manner as the white lead. The cost of this is about 5s. per cwt., and, as detection is very difficult, the temptation to adulterate is proportionally great. But how much greater must it be to the needy tradesman, who can employ it alone instead of white lead in the two first coats of his work, with scarcely a possibility of his employers knowing any thing of the matter? This in some measure accounts for the great difference that exists in the prices of painters' work. The injury done to paint by the admixture of whiting is, that it not only renders it of a much less compact body, but, causing it to be more easily acted upon by the atmosphere, renders it much more liable to be blanched and destroyed by repeated washings.

Linseed oil being the principal diluent, stands next in importance. It varies but little in quality, and is seldom adulterated; the superiority of one kind over another consisting entirely in its clearness, and being of a moderate age. It is sometimes boiled, which gives it great facility in drying, but renders it so thick and unctuous that it is only fit for out-door work.

Spirits of turpentine, of which a great deal is now used in house-painting, is also rather uniform in quality; but varies greatly in price according to the state of the market. Perhaps the only difference in its quality, consists in the manner in which it is distilled; and it is easy to distinguish what has been properly done by the absence of the resinous matter which is generally to be found in that which has been distilled with less care.

Litharge and sugar of lead are purchased by the painter in a dry state, ground in oil into a paste of a thick consistency, and used to dry and harden paint. They do not vary much in point of quality. Japanners' gold size is a liquid of which there are various qualities, the price being from 10s. to 18s. per gallon. It is used for the same purpose.

Several of the colouring pigments are equally various in quality, and the house-painter, in laying in his stock, can suit it exactly to the rates of prices at which he works; some of them varying from 9d. to 3s. per lb. according to the quality, and others, such as ochre, from 2d. to 1s. per lb. These are the principal materials employed by the house-painter in the plain department of his work; and it will now be necessary to give some account of their application.

To paint plaster properly, five coats are generally requisite; but where it is not of a very absorbent nature, four are found to answer. The first is composed of white lead, diluted with linseed oil, to rather a thin consistency, in order that the plaster may be well saturated; and into this is put a small quantity of litharge to insure its drying. In quick plaster, which is the best for painting, the oil in this coat is entirely absorbed, thereby hardening the plaster to the extent of about the eighth of an inch inwards from the surface. When this is found to be the case, the second coat should also be thin that the plaster may be thoroughly saturated; and it will be found necessary after this to give other three coats, making in all five. The second coat will be found to be but partially absorbed, and it is therefore requisite to make the third coat a good deal thicker, and to introduce into it a little spirits of turpentine, and such of the colouring pigments already enumerated, as may bring it somewhat near to the tint of which the apartment is to be finished. The fourth coat should be as thick as it can be well used, and should be diluted with equal parts of oil and spirits of turpentine. The colour of it ought to be several shades darker than that which is intended for the finishing coat, and the drying ingredient, sugar of lead instead of litharge. These coats ought all to be laid on with much care, both as to smoothness and equality, and each lightly rubbed with sand-paper before the application of the other. The finishing or flatting coat, as it is termed from its drying without any gloss, is next applied. It ought, like the others, to be composed of pure white lead, ground as already described, and diluted entirely with spirits of turpentine; and it should appear, when mixed, a few shades lighter than the pattern chosen for the wall, as it darkens in the drying. The drying ingredient should be a small portion of japanners' gold size. This coat must be applied with great care and dispatch, as the spirits of turpentine evaporate very rapidly, and if touched with the brush after that takes place, which is in little more than a minute after its application, an indelible glossy mark will be left on the surface. Nothing has been said of the time that each of the coats will take to dry sufficiently to receive the next; as that depends much on the state of the weather, the quantity of dryer employed, and the atmosphere kept up in the apartment. It may be observed, however, that under any circumstances the first coat ought to stand a few days before the application of the second; the second a little longer before the application of the third; and the third, unless in four coat work, should have still longer time to harden. But the coat immediately before the flatting or finishing coat ought not to stand above two days, as much of the beauty and solidity of the work will depend on the latter dying into and uniting with the former.

The description of this process might be sufficient to convince every one, that there could be no better mode of rendering the plaster of which the walls of our apartments are composed, impervious to the effects of our changeable and humid climate. In the first place, it hardens the surface, and then forms a compact, and smooth incrustation, upon which the dampness of the atmosphere can only condense when any sudden change takes place in the temperature. This is often exemplified in staircases, where the wall gets so low in temperature during a continuance of cold weather, that when a change takes place the condensation is so great, that the water runs in streams upon the steps. How then, we may ask, can any one employ paper-hanging, or any other absorbent mode of finishing in such apartments? It ought to be well known, that in such cases the moisture instead of being condensed and rendered easily removable, is absorbed and gradually given out in connexion with the natural effluvia of glue, rotten paste, and other noxious materials.

In many cases it has been found that this substantial style of painting is too heavy in its effect for ceilings, which require a degree of aerial lightness, especially in drawing-rooms, boudoirs, and such like apartments. In these cases, therefore, the absorption is stopped by two coats of paint, and when these are quite dry and hard, a coat of what is called distemper colour is applied; that is, white lead ground in water, and diluted with size made from the parings of white leather and parchment skins. In ordinary apartments, fine whiting may be substituted in distemper work for white lead.

The painting of the woodwork of such apartments as are not fitted up with oak or other hard woods, is a process very similar to that employed upon plaster, not only when it is to be finished plain, but also as a ground-work for imitations of the foreign woods now in use; only each of the coats should be thicker and applied with still more attention to smoothness. The imitating of woods and marbles may be termed, in house-painting, a link between that which has been already explained and is essentially simple, and that which is really ornamental. It has of late been brought to such perfection, that in some cases where the real and the imitation oak are brought into juxtaposition, as at Abbotsford, it is scarcely possible, even after examination, to distinguish the imitation from the reality. Imitations of marble have in some cases been brought to equally great perfection, but this is far from being so general.

The process of painting imitations of woods, is in the first instance, as already observed, to lay a ground-work of four or five coats of paint, taking the greatest care that no brush marks remain. This requires much more time than applying the same number of coats for plain finishing; and the last coat instead of being flatted, is composed of equal portions of oil and spirits of turpentine. The shades and grain of the wood are given by thin glazings of Vandyke brown, terra de sienna, or umber, according to the kind of wood to be imitated; which colours are ground in water and mixed with small beer, the tenacity of which is sufficient to prevent it rubbing off by the application of the varnish which immediately follows. All imitations of woods are painted in this way, except wainscot, for which a thick substance is requisite, in order that it may receive the impression of an ivory or horn comb, by which the peculiar grain of that wood is imitated. The varnish employed upon work of this kind is copal, which of all the materials used by the painter is that in which he has most latitude. The price of copal varnish is from 10s. to 42s. per gallon; so here again he can suit his materials to the price which he receives for his work.

The imitation of marbles has nothing very peculiar in its mode of execution, being more like actual painting than that employed in imitating wood; and on this account it depends more on natural taste, than on mechanical skill.

The ornamental department is likewise making great strides towards its ancient excellence, and owing to the improved taste of the present age, is beginning to be somewhat in demand. What is meant by the ornamental department, is the decorating of the walls of apartments either by original designs of pannelling and borders, or by careful imitations of Raffaelle's arabesques, Watteau's grotesque pannellings, and the Pompeian frescos; as well as decorations in imitation of basso relievo, in white and gold, polychrome and various other styles.

The want of general instruction in art, and the prevalence of the use of paper hanging, have tended to retard the progress of ornamental painting; but the former cause, through the patriotism of an individual,[1] backed by a government that has the interest of all classes in view, is, by the establishment of schools for ornamental design, in a fair way of being removed; and the latter will soon give

[1] Mr. Ewart, formerly M.P. for Liverpool.

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way to the rapid improvement which is taking place in public taste.

It now only remains to notice what we term the scientific department of house-painting, or more properly (from the improved practice of the profession) interior decoration. The fact is now no longer disputed that the rules of the highest science and art can be made available in improving our most ordinary occupations; and in no case has this fact been made more apparent than in the application of the science of chromatics or the laws of harmonious colouring to the interior decoration of our dwelling-houses. Much attention is, however, requisite on the part of the house-painter, to the *proper* application of these laws in his practice. Every practitioner in the higher walks of art, has only such a style of colouring to study, as may be suited to the general character of his subjects; but the house-painter must vary *his* style, not only according to the uses of the apartments which he decorates, but the tastes of his employers, the style of the architecture, the situation of the house, and the quarter from which each apartment is lighted. He must confine himself to neither a vivid, sombre, warm, nor cold style; all must be equally at his command. Besides, an artist has the advantage of light and shadow in toning the colours in a picture; whilst those employed in decorative painting, are all liable to be placed in full light, and must necessarily be in themselves toned to prevent that unnatural crudeness so annoying to the eye. A picture may have many excellencies to compensate for defective colouring; it may excel in one or other or all of the qualities of drawing, expression, and composition; but beyond the mere handicraft department, the works of the decorator must depend solely for their effect upon harmonious colouring.

It would exceed our limits to give even an outline of the laws of harmonious colouring, as applied to house-painting, and shall, therefore, refer the reader to the only work which has yet been written on the subject,[1] and from which we make the following extract, relative to the tone and characteristic style of colouring peculiar to the various apartments of a dwelling-house.

"The tone or key is the first point to be fixed, and its degree of warmth or coldness will be regulated by the use, situation, and light of the apartment. The next point is the style of colouring, whether gay, sombre, or otherwise. This is more particularly regulated by the use of the apartment, and the sentiments which it ought to inspire; for, as Sir Joshua Reynolds says in regard to colouring, 'what may heighten the elegant may degrade the sublime.' Unison, or a proper combination of parts, is the next consideration.

"The tone or key is generally fixed by the choice of the furniture; for as the furniture of a room may be considered, in regard to colouring, in the same light as the principal figures in a picture, the general tone must depend upon the colours of which it is composed: for instance, if the prevailing colour be blue, grey, cool green, or lilac, the general tone must be cool; but if, on the other hand, it be red, orange, brown, yellow, or a warm tint of green, the tone must be warm. But, as stated before, there can be no pleasing combination of colours without variety. This, by judicious management, may be given without in the least interfering with the tone, for it is merely the general colour of the furniture which ought to fix the tone; and there may be the most decided contrasts in its parts, which, by the introduction of proper medial hues throughout the room, can be reconciled and united. Apartments lighted from the south and west, particularly in a summer residence, should be cool in their colouring; but the apartments of a town house ought all to approach towards a warm tone; as also such apartments as are lighted from the north and east of a country residence.

"When the tone of an apartment is therefore fixed by the choice of the furniture, it is the business of the house-painter to introduce such tints upon the ceiling, walls, and wood work, as will unite the whole in perfect harmony. This is a difficult task. The colours of the furniture may be arranged by a general knowledge of the laws of harmony, but the painter's part cannot be properly added without the closest attention to the principles of art.

"The style of colouring is the next point to be fixed, and will depend entirely on the use of the apartment. In a drawing-room, vivacity, gaiety, and light cheerfulness should characterise the colouring. This is produced by the introduction of light tints of brilliant colours, with a considerable degree of contrast and gilding; but the brightest colours and strongest contrasts should be upon the furniture, the effect of which will derive additional value and brilliancy from the walls being kept in due subordination, although at the same time partaking of the general liveliness.

"The characteristic colouring of a dining-room should be warm, rich, and substantial; and where contrasts are introduced, they should not be vivid. This style of colouring will be found to correspond best with the massive description of the furniture; and gilding, unless in very small quantities for the sake of relief, should be avoided.

"Parlours ought to be painted in a medium style, between that of a drawing-room and dining-room.

"The most appropriate style of colouring for libraries is solemn and grave, and no richer colouring should be employed than is necessary to give the effect of grandeur, which can scarcely be done where one monotonous tint prevails; but care should be taken not to disturb the quiet and solemn tone which ought to characterise the colouring of all apartments of this description.

"In bed-rooms, a light, cleanly, and cheerful style of colouring is the most appropriate. A greater degree of contrast may here be admitted between the room and its furniture than in any other apartment, as the bed and window-curtains form a sufficient mass to balance a tint of equal intensity upon the walls. There may also, for the same reason, be admitted gayer and brighter colours upon the carpet.

"Stair-cases, lobbies, and vestibules, should all be rather of a cool tone, and the style of the colour should be simple and free of contrast. The effect to be produced is that of architectural grandeur, which owes its beauty more to the effect of light and shadow than to any arrangement of colours; yet they ought not to be so entirely free from colour as the exterior of a mansion, but should be in colouring what they are in use, a link between exterior simplicity and interior richness.

"Stair-cases and lobbies being cool in tone, and simple in the style of their colouring, will much improve the effect of the apartments which enter from them."

[1] Hay's *Laws of Harmonious Colouring adapted to Interior Decoration*, Edinburgh, 1836, in 8vo, 3d ed.

Pair | Pairing. | Paisley.

PAIR, two of a sort, a couple.

PAIRING, the uniting or joining in couples. The instinct of pairing is bestowed on every species of animals to which it is necessary for rearing their young, and on no other species. All wild birds pair; but with a remarkable difference between such as place their nests on trees, and such as place them on the ground. The young of the former, being hatched blind, and without feathers, require the nursing care of both parents till they are able to fly. The male bird feeds his mate on the nest, and cheers her with a song. As soon as the young are hatched, singing yields to a more necessary occupation, that of providing food for a numerous issue; a task which requires the care of both parents.

Eagles and other birds of prey build upon trees, or in other inaccessible spots. They not only pair, but continue in pairs all the year round; and the same pair procreates year after year. This at least is the case of eagles. The male and female hunt together, unless during incubation, at which time the female is fed by the male. A greater number than a single pair are never seen in company.

Gregarious birds pair, in order probably to prevent discord in a society confined to a narrow space. This is the case particularly with pigeons and rooks. The male and female sit on the eggs alternately, and divide the care of feeding their young.

Partridges, plovers, pheasants, sea-fowl, grouse, and other kinds that place their nests on the ground, have the instinct of pairing; but they differ from such as build on trees in this respect, that after the female is impregnated, she completes her task without needing any help from the male. Retiring from him, she chooses a safe spot for her nest, where she can find plenty of worms and grass-seed at hand; and her young, as soon as hatched, take foot, and seek food for themselves. The only remaining duty incumbent on the dam is, to lead them to proper places for food, and to call them together when danger impends. Some males, provoked at the desertion of their mates, break the eggs if they stumble on them. Eider-ducks pair like other birds that place their nests on the ground; and the female finishes her nest with down plucked from her own breast. If the nest be destroyed for the down, which is remarkably warm and elastic, she makes another nest as before. If she be robbed a second time, she makes a third nest; but the male furnishes the down.

Pairing birds, excepting those of prey, flock together in February, in order to choose their mates. They soon disperse, and are not seen afterwards except in pairs.

Pairing is unknown to quadrupeds that feed on grass. To such it would be useless, as the female gives suck to her young whilst she herself is feeding. If M. Buffon deserves credit, the roe-deer form an exception. They pair, though they feed upon grass, and have but one litter in a year.

Beasts of prey, such as lions, tigers, wolves, pair not. The female is left to shift for herself and her young, which is a laborious task, and often so unsuccessful as to shorten the life of many of them. Pairing is essential to birds of prey, because incubation leaves the female no sufficient time to hunt for food. Pairing is not necessary to beasts of prey, because their young can bear a long fast; and we may add another reason, viz. that they would multiply so fast by pairing as to prove troublesome neighbours to the human race. Amongst animals that pair not, males fight desperately about a female. Such a battle amongst horned cattle is finely described by Lucretius. Nor is it unusual for seven or eight lions to wage bloody war for a single female.

The same reason that makes pairing necessary for gregarious birds obtains with respect to gregarious quadrupeds, those especially who store up food for winter, and during that season live in common. Discord amongst such would be attended with worse consequences than even amongst lions and bulls, who are not confined to one place. The beavers, with respect to pairing, resemble birds that place their nests upon the ground. As soon as the young are produced, the males abandon their stock of food to their mates, and live at large, but return frequently to visit them whilst they are suckling their young.

PAISLEY, the principal town of Renfrewshire, and, in point of manufacturing importance and population, the second in Scotland, is finely situated on the banks of the White Cart, about three miles south of the river Clyde. The ancient and principal part of the town occupies the summit and slopes of a beautiful declivity, the eastern base of which is washed by the river, which divides the burgh into two parts, that on the east side being styled the New Town, from its more recent erection. Paisley is generally considered as the ancient Vanduaria of Ptolemy, and as having been a Roman town or station during the presence of these invaders in the northern part of Scotland. As late as the beginning of the last century, considerable vestiges remained of a Roman camp on the western side of the hill on which Paisley is built; but these have long since been obliterated by the progressive extension and improvement of the town. The latitude of Paisley is 55. 48. north, and the longitude 4. 26. west. The climate is temperate, but humid. Inflammatory and pulmonary complaints are prevalent, and infectious diseases have been of rather frequent occurrence in its history. In 1645, a pestilence committed great ravages in this place; and in 1765 dysentery prevailed to an alarming extent. In 1771, pleurisy carried off numbers of the inhabitants; and a virulent influenza visited it in 1803, 1830, 1831, and in the beginning of 1837. Paisley is not, however, considered as unhealthy, nor is its mortality above the average of other large manufacturing cities. Whether the Roman town or station called Vanduaria was a place of any size or importance, ancient chronicles are entirely silent. A dark cloud overhangs the history of Paisley till about the year 1163, when Walter, the first Stewart, founded a monastery on the eastern bank of the Cart, opposite to what is now termed the Old Town of Paisley. At this period there does not appear to have been a village or hamlet, however small, in existence; but the protection which the monastery afforded in those rude times, and the multitude of pilgrims, travellers, and persons of distinction, who frequented it, gradually induced a population to assemble in its vicinity; and a village of some extent made its appearance on the western bank of the river, and began slowly to clamber up the gentle slope of the hill on that side. In 1220, the monastery was elevated to the dignity of an abbey, and many valuable privileges were subsequently conferred upon it by the pope, and by its founder and successive patrons. Its jurisdiction and revenues were very extensive, extending to, and being derived from, localities at a great distance; its abbots were commonly men of the highest family connections, and appear frequently as prominent actors on the stage of Scottish civil and ecclesiastical history. After the Reformation, the revenues and privileges of this ecclesiastical establishment were bestowed upon Lord Claud Hamilton, and have since become the property, though greatly reduced, of the noble family of Abercorn. A considerable part of the ancient abbey still remains, and is in excellent preservation. The skeleton of a beautiful window, thirty-five feet in height by eighteen in breadth, almost the only fragment of the more ancient part of the building, has been much admired for its size, lightness, and fine proportions. The external architecture of the remaining portion is perhaps scarcely equal to that of some other ecclesiastical edifices in Scotland; but the ap-

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pearance of the nave, which is occupied as a parish church, is grand and striking in no ordinary degree; and some few fragmentary remains of the old monastery exhibit fine specimens of the purest Gothic. Before the accession of the Stuart family to the throne of Scotland, their burying-place was in the abbey; and even after that event, two of its members were interred there, namely, the queen of Robert II. in 1387, and Robert III. in 1406. The tomb of Marjory Bruce, the daughter of Robert I. is still to be seen in the famous sounding aisle, now occupied as a burial-vault by the Abercorn family.

Notwithstanding the wealth and manufacturing importance of Paisley, it is only a burgh of barony; but its privileges are so very considerable as almost to equal those of a royal burgh. Previously to 1770, the burgh had a vote in the election of a member of parliament for the county. Now, by the Scottish Reform Act, Paisley sends a member to represent it in parliament. The constituency in 1837 was 1484. Formerly the government of the town was vested in a provost, three bailies, and seventeen councillors; but by the Scottish Burgh Reform Act there are now a provost, four bailies, and ten councillors.

In 1553, John Hamilton, the last abbot, conveyed, by a deed, the revenues and privileges of the abbacy to Lord Claud Hamilton, then a child of ten years of age: he was afterwards deprived of the latter, on account of his adherence to the fortunes of Queen Mary, but in 1591 they were restored, with the title of Lord Paisley. In 1653, the second Earl of Abercorn disposed of his interest in the abbacy to the Dundonald family; and in 1658 the magistrates and council purchased this superiority, and since that time Paisley has held directly of the crown. The old valuation of the burgh-lands was a thousand pounds Scotch. The town's revenue, from various sources, such as lands and houses, river-dues, and various other civic items, amounts to L.3843. 12s. 7d., and the supposed value of the burgh property is about L.50,000; but, deducting debts and other obligations, its nett amount may be L.20,000.

The topography of Paisley and its vicinity is not very remarkable. Previously to the year 1736, the whole of this district was included in one parish, known by the name of the parish of Paisley; but since that time the burgh has been divided into three parishes, the High, the Middle, and the Low. The Abbey parish now comprehends the New Town, which, with a trifling exception, is separated from the burgh by the river Cart, and the populous villages of Johnstone, Elderslie, Thorn, Quarrelton, Nitsil, Hurlet, and Dovecote Hall, with the country districts. To the north, and affording a noble view from the eminence on which Old Paisley is chiefly built, extends the great plain of the lower valley of the Clyde, anciently called Strathgryffe. On the south, the Gleniffer, or Paisley Braes, distant about three miles, swell gently up to the height of 760 feet above the surface of the Cart. The soil is of a mixed character, generally poor and thin, but in many places rich and fertile. From the heights just mentioned descend a variety of minor streams, of great utility to the agriculturist and the manufacturer, and adding to the richness and beauty of the scenery. The surface of the country in the neighbourhood, with the exception of that to the north, which is flat, is agreeably diversified, and broken into gentle swells and soft declivities, which, with the mixture of gentlemen's seats, farm-houses, bleaching-fields, and other public works, confers a picturesque and animated character upon the entire vicinage. Valuable minerals abound in the parish, such as coal, limestone of the coal formation, and ironstone; though the latter is not smelted, at least to any extent, but is sent to the Lanarkshire furnaces. There are very extensive coal-pits wrought in the neighbourhood, chiefly at Johnstone; and in that vicinity, and at Hurlet, the chemical works of the Messrs Wilson at Thornly are on a very large scale. Very fine freestone is also obtained in the neighbourhood.

As it is chiefly, however, to its being one of the principal manufacturing stations in the kingdom that Paisley owes its celebrity, we shall now present a brief sketch of the history, progressive improvement and increase, and present extent, of its principal manufactures. There is no certain account as to the precise period when the art of weaving was introduced. It appears, however, that the manufacture of linen was carried to a considerable extent during the last century. Shortly after the union, the spirit of manufacturing enterprise sprung up in the west of Scotland, and Paisley was not slow in availing itself of the general impulse. Craufurd, describing the state of Paisley in 1710, observes, "That which renders this place considerable, is its trade of linen and muslin, where there is a great weekly sale in its markets, of those sorts of cloth; many of the inhabitants being chiefly employed in that sort of manufactory." From 1744 to 1784 the linen manufacture increased in amount from L.18,886. 15s. 10d. to no less than L.184,385. 16s. 6½d. About the year 1722, the manufacture of linen thread was introduced into Paisley, and carried on to a large extent. For several years it reached the amount of L.100,000 annually. Cotton thread, having superseded that made from linen yarn, is manufactured to a very considerable extent, and forms one of the principal manufactures of the place. In 1760, silk gauze began to be manufactured in Paisley; and in a short time the skill and ability with which this manufacture was prosecuted caused its abandonment by the manufacturers of Spitalfields, the original seat of the silk manufacture in Great Britain. This manufacture flourished extensively until near the close of the last century. From 1772 there existed also a considerable manufacture of ribbons, and other articles in silk. It has been calculated, that in 1784 the value of the manufactures of Paisley, in silk gauzes and other silk goods, linen lawns, linen gauze, and sewing thread, was L.579,185. 16s. 6d., and that in 1769 it amounted to L.660,385. 16s. sterling. In 1744, only 867 looms were employed in the weaving of linen; and forty years afterwards no fewer than 5000 looms were engaged in the manufacture of silk, the produce of which amounted to L.350,000.

Towards the end of the last century, from the caprice of fashion, and the gradual introduction of the cotton manufacture, the making of silk goods declined rapidly; but a new species of manufacture sprung up, which has since been carried to a much greater extent. The manufacture of shawls, of cotton, silk, and fancy woollen fabrics, was introduced, and has now become the staple trade of Paisley. Although little more than forty years have elapsed since its introduction, this manufacture is so extensive, that in 1834 the value was calculated to be about a million sterling; and since then it is understood to have increased considerably.

Previously to the present century, fine shawls had been manufactured in this country, chiefly at Norwich and Stockport in England, where they were made in imitation of the rich India shawls. The latter, from their high price, were beyond the reach of all but a few wealthy individuals, when the manufacturing skill and enterprise of Paisley embarked in the manufacture, and, by successive inventions and improvements in the loom, and in the kind and quality of the materials, prosecuted for a long series of years, succeeded in realizing a nearly perfect imitation of those oriental fabrics, in colours, texture, and design, and at a mere fraction of the cost. Besides the extraordinary cheapness, the variety of new and beautiful fabrics and designs which have been introduced into the shawl manufacture have largely contributed to its extent and success. The manufacture of shawls is almost wholly confined to Paisley; but a considerable proportion of these find their way to the

 Glasgow markets for home and foreign sale. The kinds produced are various in quality and cost, and there is a great variety in the styles and fabrics. Some are wholly made of silk, but these are not now much in demand; others of silk and cotton, and a great many of Persian and fancy wools mixed with both or either. Thibet-cloth shawls, a very rich and fanciful fabric; Chenille shawls, a beautiful imitation of silk velvet; Canton crape shawls; and various other and newer kinds, of every possible variety in size, texture, pattern, and price; are produced from the looms of Paisley, with a rapidity and abundance which, whilst it tends occasionally to overload the market, affords satisfactory evidence of the manufacturing skill and resources of Paisley. The present annual amount of the trade and manufactures of Paisley has been roughly calculated at nearly two millions sterling. To give any thing like a view of the various inventions and improvements in the art of weaving, by means of which Paisley has attained its present eminence as a chief seat of the silk and cotton manufactures in Scotland, would swell this article beyond all due bounds. The hasty sketch which we have supplied affords some general data to the reader, who may consult, if he wishes for more minute information, Wilson's Survey of Renfrewshire; Craufurd's Description of the Shire of Renfrew, with Robertson's continuation; and the New Statistical Account of Scotland. The spinning of cotton yarn is also extensively carried on by Paisley manufacturers in the town and parish, but there are no data to be relied on for ascertaining its annual amount. Bleaching and dyeing are, as might be expected, prosecuted to a very considerable extent. Soap-making is a trade of some antiquity and importance; and malting, the distillation of raw spirits, and silk throwing, have also a considerable capital embarked in them.

Under the head of General Statistics we may notice the increase of the population in Paisley from 1791 to 1835. In 1695 the population of the town of Paisley, exclusively of the Abbey parish, where there were then very few houses, was only 2200. In 1755, sixty years after, it amounted in the town and Abbey parish to 6799; and in 1781 to 11,100 in the town alone, the population of the Abbey parish not being given in the register.

In 1791 the total population was	24,592
... 1801	31,179
... 1811	36,722
... 1821	47,003
... 1831	57,466

The population may now be assumed at about 65,000, according to the ordinary increment of increase. Thursday is the market-day in Paisley, and there are four fairs annually, which last three days each. The races at St James's Fair are well known in the west of Scotland, and attract great numbers from the surrounding districts. For the last three or four years these races have been much frequented by the sporting world. Race-horses of high celebrity have made their appearance on the course; and a great deal of money, it is understood, has changed hands. Paisley is abundantly supplied with the means of external communication; and when the Ayrshire and Greenock railways are completed, few towns in the empire will possess equal facilities for traffic or travelling. By the canal betwixt Glasgow, Paisley, and Johnstone, no fewer than 423,186 passengers were conveyed, from the first of October 1835 to the first of October 1836. From the latter period, however, to the first of October 1837, the number had decreased to 386,157, owing to other means and modes of locomotion being opened up. After the railway to the Clyde near Renfrew, which is from two to three miles in length, was opened, in the spring of 1837, about 50,000 passengers passed along it, going up and down the river, during the first seven months; and no fewer than 100,000 persons were carried by coach to and from Glasgow, from October 1836 to the same time in 1837. The carriage of goods on the canal has increased from 48,991 tons in 1831, to 67,305 tons in 1836. The yearly returns of the post-office afford additional evidence of the growing prosperity of Paisley.

In 1720 the amount was only	L.28	13	0
... 1769	223	3	8
... 1809	2814	17	4
... 1834	3194	0	0

The river Cart is navigable to Paisley for vessels of from sixty to eighty tons burthen; but the improvements in progress upon the river, by deepening, and removing various other obstacles to the navigation, for which an act of parliament has lately been obtained, are expected greatly to increase the facility of external traffic. The river dues in 1835 amounted to L.260. An act of parliament has also been obtained to make a cut from the Forth and Clyde Canal, to enter the Clyde as near as possible to the confluence of the Cart with that river; an undertaking which will be highly advantageous to the Paisley manufacturers, by affording them a cheaper and more expeditious transit for their goods to London and the continental markets, for which a large portion of their manufactures are prepared.

The antiquities of Paisley, with the exception of its abbey, of which we have already spoken, are hardly worth mentioning. There are a few old castles in the vicinity, in a state of lesser or greater dilapidation; but, with the exception of that of Crookston, once the property of the family of the feeble and worthless Darnley, and which, from its commanding situation on a richly-wooded slope, about four miles to the east of Paisley, and its air of venerable antiquity, forms a most picturesque feature in the general landscape, none of them possesses much interest, either historically, or as agreeable accessories in the general scenery.

Notwithstanding the enterprising and intellectual character of the inhabitants of Paisley, the means of education are not so abundant as might be expected. From a report by the presbytery to the General Assembly in 1834, the number of schools in the town and Abbey parish was only sixty-five, and the scholars amounted to 4776. Since then, however, considerable exertions have been made to remedy this deficiency. Government lately granted L.700 to the burgh for educational purposes; and this sum, aided by liberal subscriptions from the citizens, and the exertions of the general session and various philanthropic individuals, has provided the means of education for a large additional number.

The town is well lighted with gas, and an act of parliament has lately been obtained by a public company to supply it with water from the neighbouring heights. The assessment for the poor for 1838 is L.3500 for the three town parishes. The only public building in Paisley of any importance, with the exception of the abbey, is the county-jail and public offices, an edifice of considerable extent, castellated in style, and standing in a fine situation on the western bank of the Cart. The news-room at the cross is also a handsome building. There are three bridges over the Cart, connecting the Old and New Town of Paisley, but none of them is particularly remarkable.

The civil history of Paisley affords little to interest or deserve the attention of the general reader. Its ecclesiastical history is curious and interesting, but supplies few points sufficiently salient and compact to be entered upon in so brief a sketch. The famous "Black Book of Paisley," which was long supposed to have been a history of Paisley and its monastery, has been ascertained to be the *Scotichronicon* of Fordun, a monk of the fourteenth century. Manuscript copies of this curious old work, with continuations by Bowmaker and others, are in the College Library at Edinburgh, and in the British Museum. The Chartulary or Register of the Monastery of Paisley, printed in 1832, at the expense of the Earl of Glasgow, president of the Maitland Club, is a valuable document, containing much curious information respecting those primitive times. Previously to the Reformation, Paisley was a place of little importance. The neighbourhood of its abbey, however, with the presence of its lordly abbots and their distinguished guests, conferred upon it considerable dignity even then, and drew into it the neighbouring gentry, who, down to a comparatively recent period, had family mansions in the town. The inhabitants early embraced the doctrines of the Reformation, notwithstanding the naturally adverse influences of their great monastic establishment; and displayed their attachment to these on various occasions during the civil wars and prelatical persecutions of the seventeenth century. In 1715 and 1745, they showed equal zeal for the house of Brunswick; and the burgh had to pay a fine of L.500 to the Young Chevalier, at the latter period, as a composition for its anti-Jacobite predilections. The magistrates afterwards memorialized government for compensation, but they never obtained it. In 1597, the queen of James VI. honoured the inhabitants with a visit to their town, when it would appear that the royal entertainment fell so heavy on the burgh funds, that in 1617, when her royal consort also visited it, the civic dignitaries prudently forbore so costly a welcome, but in lieu thereof employed "a prettie boy, a son of a Sir James Semple of Beltrees," to make him a speech, which, from the extracts of it we have seen, was judiciously spiced for James's royal ear. Its modern history is comprised in the progress of its manufactures, and the improvement of the town in all its interests and appearances, of which we have supplied this brief analysis.

PAITA, or PAYTA, a town of Peru, in the department of Truxillo. It stands on a bay of the same name, situated in 5. 2. of south latitude. A hard sandy beach extends round the harbour, which is completely sheltered from all prevailing winds. The port is a rendezvous for American whale-ships. It is the seaport of Piura, fourteen leagues in the interior, and carries on a considerable coasting trade. The exports from Paita are cinchona, rhatany, silver, and wool. This town has suffered as much from the invasions of the buccaneers as any port of the Pacific. It was also burned by Lord Anson in 1741, and by Lord Cochrane in 1810; yet the importance of its position has always led to its reconstruction. The population amounts to about 3000.

PAITAN, a district on the north-eastern coast of Borneo, containing a bay and river of the same name. The bay is greatly encumbered with shoals, and the coast on both sides is extremely foul. The country around produces abundance of camphor.

PAKIR, a seaport of Arabia, situated on the coast of Hadramaut, from which a considerable trade is carried on with India. The environs abound in cattle, grain, and dates. Pakir is twenty-five miles east of Dofar.

PALACE, PALATIUM, a name generally applied to the dwelling-house of a king, prince, or other great personage. It takes different epithets, according to the quality of the inhabitants, as imperial palace, royal palace, pontifical palace, cardinal palace, ducal palace, episcopal palace, and so on.

PALACHY, a town of India, in the province of South Coimbetoor, containing 300 houses, and a small temple, with a small fort adjacent. Palachy is 121 miles south by east from Seringapatam. Long. 77. 8. E. Lat. 11. 47. N.

PALÆMON, Q. RHEMMIUS, a famous grammarian of Rome, in the reign of Tiberius, who was born of a slave, at Vienza. We are told he was first brought up to the business of a weaver; but attending his master's son to school, he profited by this opportunity of attaining knowledge, and acquired so much skill in common learning, that he obtained his freedom, and became a teacher or preceptor at Rome. His claim to learning cannot be questioned, since he is recorded as a scholar even by Juvenal. Only some fragments of his works remain.

PALÆOLOGUS, MICHAEL, a very able man, who was governor of Asia under the Emperor Theodorus Lascaris; and who, by various stratagems and cruelties, procured the empire for himself and his posterity. See CONSTANTINOPOLITAN HISTORY.

PALÆPAPHOS, a town of Cyprus, where once stood a temple of Venus; and an adjoining town called *Neo Paphos*, where St Paul struck Elymas blind, and converted the proconsul Sergius Paulus.

PALÆSTRA, in Grecian antiquity, a public building where the youth exercised themselves in wrestling, running, playing at coits, and other feats of strength and skill. To prevent the combatants from hurting themselves by falling, the bottom of the palæstra was covered with dust or gravel. Some think that the palæstra was only a part of the gymnasium. Many authors also imagine that the palæstra was of two kinds, the one for the exercise of the body, the other for the cultivation of the mind; but the derivation of the word seems to confine it exclusively to bodily exercise.

PALALAIKA, or BALALAIKA, a rude kind of guitar with two strings, which is common in Russia.

PALAMEDES, a Greek chief, son of Nauplius, king of Eubœa, by Clemene. He was sent by the Grecian princes who were going to the Trojan war, to bring to the camp Ulysses, who, in order to avoid the expedition, pretended insanity, and, the better to carry on the imposition, often harnessed different animals to a plough, and sowed salt instead of barley. But Palamedes soon discovered the cheat. He knew that regret to part with Penelope, whom Ulysses had lately married, was his only reason for pretending insanity; and to demonstrate this, Palamedes took Telemachus, of whom Penelope had lately been delivered, and put him before his father's plough. Ulysses turned the plough a different way, not to hurt his child. He was therefore obliged to attend the Greek princes to the war; but a mortal enmity took place between Ulysses and Palamedes. The king of Ithaca determined to take every opportunity to distress him; and when all his attempts were frustrated, he had recourse to a base stratagem, and had Palamedes unjustly accused and convicted of treason, and stoned to death by the army. Palamedes was a man of learning as well as a soldier; and, according to some, he completed the alphabet of Cadmus by the addition of the four letters θ, ξ, χ, φ, during the Trojan war. To him also is attributed the invention of dice and backgammon; and it is said that he was the first who regularly ranged an army in order of battle, and who placed sentinels round the camp, and excited their vigilance and attention by giving them a watchward.

PALAMOW, a district of Bengal, situated on the western frontier, between the 22d and 25th degrees of north latitude. It is bounded on the north by Rhotas; on the south and west it touches different wild districts of Gundwaneh; and on the east it has Ramgur. It is the least populous and worst cultivated of any district in British India. It contains, however, both iron and coal; but the natives are not sufficiently advanced in civilization to explore the mines. The Burnah or Cayle River, which falls into the Soane, flows through it; and on its stream timber and other heavy articles might be floated down to Patna, if the country were more civilized. The principal towns are Palamow and Jaynagur. The former, the chief town of the district, is situated in a valley on the eastern side of the Cayle River, and is the residence of a rajah or zemindar. Long. 78. 10. E. Lat. 23. 52. N.

PALAPETTY, a town of Hindustan, in the district of

Palar || Pale. Palembang.

Dindigul, thirty miles north from the town of Dindigul. Long. 78. 10. E. Lat. 10. 40. N.

PALAR, a river of the south of India, which has its rise in the province of Mysore, and, after a course of 200 miles, falls into the Bay of Bengal near Sadras.

PALARIA, amongst the Romans, a kind of exercise performed at a stake by the soldiers. The stake being fixed in the ground, and six feet in height above it, the young undisciplined soldiers advanced against it, armed with a hurdle and cudgel instead of a sword and shield, and went through all the rules of attack and defence, as if actually engaged with an adversary. Sometimes they stood at a distance, and attacked with missive weapons; at the same time using all the requisite motions for defending themselves, and warding off what might be thrown against them.

PALATINATE, a province or signiory, possessed by a palatine.

PALATINATE of the Rhine, a province of Germany, divided into two parts by the Rhine, called the Upper and Lower Palatinate.

PALATINE, or COUNT PALATINE, a title anciently given to all persons who had any office or employment in the prince's palace, but afterwards conferred on those delegated by princes to hold courts of justice in the provinces, and on such amongst the lords as had a palace, that is, a court of justice, in their own houses.

PALATINE-GAMES, in Roman antiquity, were games instituted in honour of Augustus by his wife Livia, after he had been enrolled amongst the gods. They were celebrated in the palace, whence the name, and were confirmed by the succeeding emperors. Some authors say that these games were instituted in honour of Julius Cæsar, and others again confound them with the Ludi Augustales; but neither of these opinions seems to be well supported.

PALATSHA, a village of Anatolia, in Asia Minor, situated near the coast of the Mediterranean. It is supposed by some to be the ancient Miletus, whilst others believe the ruins to be those of Myus, an ancient town, ultimately incorporated with Miletus. Long. 27. 12. E. Lat. 37. 31. N.

PALAWAN ISLE, a large island in the Eastern Seas, estimated at 275 miles in length, and thirty-two miles in average breadth. It stands between the northern extremity of Borneo, with which and the Philippines it forms an extensive chain of islands. The country is described as being flat to the bottom of the hills. Its productions are cowries, wax, tortoise-shell, and sea-slug or *biche de mer*, the last being abundant. It contains much ebony and laka-wood; also hot springs and mines of gold.

PALAZZOLA, a city of the island of Sicily, in the intendancy of Siragosa, and district of Noto. It is situated on a high mountain, the ancient Erbessus, in a humid atmosphere, 130 miles from Palermo. It contains 8500 inhabitants, chiefly cultivators.

PALCATI NOR, or BALKASH, a lake of Northern Tartary, extending about 200 miles from north to south, and 110 from east to west. It is situated 700 miles east from the Aral. Its waters, though somewhat brackish, are not altogether unfit for drinking. It contains several small lakes near its southern extremity. On the west it has the country of the Kirghisses, and on the east the great plateau of Soongaria.

PALCOTE, a town of Bengal, in the province of Bahar, and district of Chuta Nagpore, 200 miles west by north from Calcutta. Long. 85. 0. E. Lat. 22. 58. N.

PALE, a little pointed stake or piece of wood used in making enclosures, separations, and the like. The *pale* was an instrument of punishment and execution amongst the ancient Romans, and still continues so amongst the Turks.

PALEMBANG, a district of Sumatra, on the north-eastern coast, extending along the river Palembang, which rises within two days' journey of Bencoolen, and runs nearly across the island. It is upwards of a mile in breadth opposite to the town of Palembang and the Dutch factory, and may be navigated by vessels which do not draw more than fourteen feet depth of water. In its lower parts, towards the sea-coast, the country is described as flat and marshy, and, with the exception of a few tracts, entirely unfit for cultivation. The produce of this country consists chiefly of pepper, rattans, gambir, silk, cotton, damor, ivory, cat's-eyes, sulphur, salt, wax, rice, benzoin, indigo, tobacco, areca, buffaloes, and gold. The pepper trade is very profitable. The port is much frequented by trading vessels, chiefly from Java, Bally, Madura, and Celebes, which bring rice, salt, and cloth, the manufacture of these islands. With opium, the piece-goods of India, and European commodities, it is supplied by the Dutch from Batavia, and by interlopers. These in return receive pepper and tin, which were formerly monopolized by the Dutch East India Company to the amount of about two millions of pounds, one third of which was shipped at Batavia for Holland, and the remainder sent to China. The interior parts of the country are divided into provinces, each of which is assigned as a fief or government to the royal family, or to the nobles, who commit the management to deputies, and are little interested about the welfare of their subjects. The power of the monarch is unlimited; but not maintaining any permanent body of troops, his nobles often contemn his orders; and power in this case belongs to the stronger party. He has no revenue except what arises from his monopolies, and from the produce of the customs; but the amount of these, especially that arising from pepper and tin, is considerable. The population, with the present rulers, is said to have come, a great portion of it, originally from Java; though, according to the opinion of the best authors, Palembang is the original country of the Malay race. The policy of the princes having always been to encourage foreign settlers, the city and lower parts of the river are in a great measure peopled with natives of China, Cochin-China, Camboja, Siam, Patani, on the coast of the peninsula; Java, Celebes, and other eastern islands. In addition to these, the Arabian priests are described by the Dutch as a very numerous and pernicious tribe, who impose upon and plunder the credulous inhabitants, and are nevertheless held by them in great reverence. The Mahommedan religion prevails throughout all the dominions of the sultan, with the exception of a district near the sea-coast, where the natives live in the woods like the brute creation. The natives are described by the Dutch as devoid of every good quality. But the Dutch are generally at enmity with the natives in their colonies, irritating them by their tyranny and oppression; and hence it is not unusual for others who treat them differently to find their characters exactly the reverse of the portrait drawn of them by the Dutch. They have, besides, little knowledge of their character, owing to the jealousy and alarm of the Palembang government at every attempt to penetrate into the interior.

In the year 1812 the kingdom of Palembang was conquered; and the sultan, who had made himself universally odious by his cruelties, having been dethroned by a handful of British troops under the orders of Colonel Gillespie, his brother was raised to the throne in his stead. The expedition which was sent against this tyrant, being detained in the river of Palembang in the ascent to the capital, and Colonel Gillespie learning that the sultan in his rage had come to the resolution of putting to death all the wealthy Chinese and the other merchants, penetrated to the capital with a small party of about seventeen grenadiers, and, entering the palace, fortified themselves until

Palembang || Palencia.

the other troops arrived, and thereby prevented the intended massacre, and completed the overthrow of the sultan's despotism.

Palembang, the capital of the above district, and a great emporium of inland commerce. It is situated in a marshy tract of flat ground, a few miles above the delta of the river, and about sixty miles from the sea. It is so intersected by the branches of the river, forming a number of islands, that it has received the appellation of the City of Twenty Islands. It extends about eight miles along the banks of the river. The houses of the sultan and his son are square areas, surrounded with very high brick walls. Each of these palaces contains several detached buildings of the pavilion form, having portions of ground planted with fruit-trees and ornamental shrubs. In front of these palaces is an extensive battery facing the river. There is also a lower range of batteries; and between the two is seen the Maidan or Plain, at the extremity of which appears the hall where the sultan gives audiences to the public. The sultan, before the arrival of the British, had been engaged in the construction of a new harbour, for which he had found materials in the Dutch factory, which he had demolished. It joins the inner palace, but the buildings are still incomplete. A large reservoir of water, with pleasure-boats in it, occupies the middle of this area, which is surrounded by numerous detached buildings for the females of the court. The principal mosque is a pretty large building, nearly square; and adjoining it is a high octagonal tower, from which the muezzin calls the people to prayers. The houses of the common people are made of bamboos, with mats, and thatched. Some of the houses float on the river, to the banks of which they are attached. About two miles above Palembang the river divides into two large branches; that on the left leading to a country-seat of the sultan, consisting of several bungalows and gardens delightfully situated on a cluster of small islands. The inhabitants amount to between 20,000 and 30,000, and consist of Malays, Chinese, and Arabs. Long. 104. 54. E. Lat. 2. 58. 51. S.

Palembang, the river on which the city of the same name is situated, rises within two or three days' journey of Bencoolen, and falls into the Straits of Banca. The river, with the exception of the bar at its mouth, on which there are two fathoms and a quarter, has a depth sufficient to carry a frigate as far up as the town. It is of considerable breadth, with low and woody banks.

PALEMERDY, a town of Hindustan, in the Southern Carnatic, district of Madura, thirty-one miles south-east from the town of Madura. Long. 78. 23. E. Lat. 9. 26. N.

PALENCIA, a province in Spain, forming part of the ancient kingdom of Leon. It extends 145 square leagues, and the number of its inhabitants is 118,064, a density of population much greater than the general average of the kingdom presents. As the province is well watered, the riches and population, which in Spain must arise from the abundance of that element, are on the advance. The rivers that water it discharge themselves at last into the Duero, and are the Pisuerga, the Carrion, the Arlanza, and the Arlanzon. The country is generally fertile in the valleys, and yields wheat, barley, and wines. There are some coarse woollen manufactories scattered over the province, as well as in the capital city. The Canal of Castille runs through this province as far as it is executed. This, like the Canal of Aragon, is designed to promote two important objects, that of internal navigation and that of irrigation. The part of this valuable and costly work that is completed begins in the village of Alar del Rey, in latitude 42. 51., taking its water from the Pizuerga, the left bank of which it follows. It enters the kingdom of Leon by crossing that river, and then continues on its right bank, crossing also the Cieza, when it makes a turn to the city of Palencia, and terminates in the Carrion, a little below it. A branch called the Canal de Campos runs from it to the westward, towards Beceril. The masonry of this work is stupendous and well executed, as are all the locks, sluices, and other appendages. Such great operations always proceed slowly in Spain, and the recent struggles have created considerable impediments; but if the project be successfully pursued, and the original plan completed, this canal will connect itself with that of Aragon, and thus create an internal navigation across the whole of Spain. There are made in this province 500,000 hogsheads of wine, and 2000 of brandy. It possesses 3050 horses, 6500 mules, 3800 asses, 9300 oxen, 318,500 sheep, 11,300 goats, and 5500 pigs. It is in the captain-generalship of Zamora, and enjoys the privileges and laws of Castille.

Palencia, a city of Spain, the capital of the province of Leon. It is situated on the banks of the river Carrion, after that river has been increased by the junction of the Cieza. It is the see of a bishop, and has a large and ancient cathedral. The country around produces good wheat, barley, and wine, especially in moist summers; but it has a barren appearance, from being almost wholly destitute of trees. It is a manufacturing place, and furnishes blankets, coverlets, baize, serges, and hats, to a great portion of the inhabitants of its own and the surrounding provinces. It is not considered as a healthy city, from its vicinity to a most pestiferous stagnant lake called Nava. It is situated in longitude 4. 34. west, and latitude 42. 10. north, has a population of 8292 souls, and contains five churches, eleven monasteries, and two hospitals.

PALENGA, a village of Hindustan, in the province of Sinde, situated in the route from Hyderabad to Luckput Bunder. Lat. 24. 19. N.

PALERMO, a province or intendancy of the island of Sicily, belonging to the kingdom of Naples. It is formed out of the Val di Mazzara, and some portions of the Val di Demona. It is situated on the sea-shore, which is its western boundary, and is bounded on the east by Messina, on the south by Calataniferra and Girgenti, and on the east by Trapani. It is divided into four districts, viz. Palermo, Cefalu, Corleone, and Termini, and contains 410,000 inhabitants. The capital of the island, as well as of the intendancy, is the city of Palermo. It stands upon a beautiful gulf of the same name near Cape Gallo. It has a fine mole running out nearly a quarter of a mile from the arsenal, with a lighthouse, which forms a convenient harbour. The city is built upon a fertile plain; and the air in general is salubrious, but in some parts malaria is generated in autumn. Most of the houses have fountains, which contribute much to cleanliness. It is a well-built and not inelegant city. The most prominent buildings are the royal palace and the cathedral. There is an university, with a library, and a good observatory. Many fine specimens of Moorish architecture are still to be seen. The trade is considerable, and includes many articles produced in the island. It contains about 180,000 inhabitants. Long. 13. 20. 15. E. Lat. 36. 6. 44. N.

PALES, in Pagan worship, the goddess of the shepherds, to whom they offered milk and honey, in order that she might deliver them and their flocks from wild beasts and infectious diseases. This goddess is represented as an old woman. Her festivals, called *Palilia*, were celebrated on the 21st of April, the day on which Romulus began to lay the foundation of the city of Rome; the ceremonies consisting in burning heaps of straw, and leaping over them. Some call the festival *Parilia* (*quasi a pariendo*), because the sacrifices were offered to the divinity for the fecundity of the flocks.

PALESTINE.

Palestine.

Palestine.

PALESTINE, though a country of limited extent, has yet been the scene of events that will ever be memorable in the history of the world. It was in this fruitful land, flowing with milk and honey, that the chosen people of God, redeemed from Egyptian bondage, and crowned with conquest, were appointed to rest from their toils, after their long and laborious pilgrimage through the wilderness. Here they dwelt in peace, and in the enjoyment of all earthly blessings. Corrupted by prosperity, they provoked the vengeance of heaven by their ingratitude and rebellion, and were again, for their iniquities, swept into captivity in an unknown and hostile land. Restored to their country through the favour of the Persian king, they relapsed into their former evil courses; and filling up the measure of their guilt by putting to death the promised Messiah, they were abandoned by Heaven to the rage of their enemies, and finally escaped, a miserable remnant of unhappy fugitives, from the flame and the sword, which devoured their country and ruined its cities, and were dispersed amongst all nations, an astonishment and a by-word, as it was foretold they would be, to all succeeding generations, and a living evidence of the truth of those prophecies of which they are the subject. In the mean time the Christian revelation published at Jerusalem gradually extended its influence, until its authority was acknowledged by the Roman emperor, and throughout his whole dominions, and, finally, in all those European kingdoms into which the Roman empire was broken by its barbarous invaders; and thus was brought about, not by the violence of conquest, but by the peaceful triumph of a purer faith, one of the most extraordinary revolutions ever known in the manners, laws, institutions, and morals, of a large portion of the civilized world. In the middle ages, the deliverance of the holy city was the reigning delusion of that barbarous time; the war-cry was raised throughout all Europe against the infidels who dishonoured Jerusalem by their presence, and interrupted the pilgrimage to that holy place; the knights of Christendom, obedient to the call, assembled from all quarters round the banner of the cross; and vast armies were transported from Europe to Asia, to contend with the Mahommedans for the possession of the Holy Land. A long, bloody, and doubtful war terminated in the triumph of the infidels, and finally consigned the land of Palestine to their barbarous sway. A country which has been the scene of such various revolutions, and of so many marvellous events, in which the light of divine truth was first displayed, once so famed, and now so degraded, cannot fail to be regarded with deep interest in a liberal and enlightened age, affording, as it does, so many curious topics of discussion, and so wide a field of interesting inquiry. It has accordingly been resorted to, especially in modern times, by numerous travellers from Europe, whose works contain the most ample details concerning its natural features, its scenery, productions, animals, its antiquities, the manners of its inhabitants, and its present condition; and it is from the copious information contained in these works that the following narrative has been compiled.

Description.

The tract of country known in modern times under the name of Palestine forms, for about 140 miles, from the thirty-first to the thirty-fourth degrees of north latitude, the eastern shore of the Mediterranean; whilst it is bounded on the east by the great Syrian desert, on the north the mountains of Libanus and Anti-Libanus form a natural boundary, and on the south it extends to the Arabian desert. It is 140 miles in length, as already mentioned, and about fifty in breadth; and is distinguished by the inequality of its surface, and by the varied scenery which it presents; "a land," says Sandys, with his usual force, "that flowed with milke and hony; in the middest, as it were, of the habitable world, and under a temperate clime; adorned with beautiful mountaines and luxurious vallies; the rockes producing excellent waters; and no part of it empty of delight or profit."[1] Along the sea-coast of Palestine, the country consists chiefly of fertile and extensive plains, from which the ground gradually rises by successive terraces or ridges, into the central range of mountains which intersect the country throughout its whole length, and which present, with intervening valleys of singular beauty, all the varieties of bold and rugged scenery, and often sterile and naked rocks. On the eastern declivity of these mountains the country is rich, diversified, and luxuriant; its lofty mountains and sloping hills covered with forests, the deep valleys watered by murmuring streams, and clothed with cultivation, or enlivened with the flocks and herds of the wandering Arabs.[2]

Those mountains which form the central chain of Judea run parallel, under various names, to the shore of the Mediterranean, being in general at the distance of twenty or twenty-four miles from the sea; Mount Libanus forms the summit, and they divide into two distinct chains, the greater on the west, which looks to the Mediterranean, and the lesser on the east, which bounds the plains of Damascus, and has received the appellation of Anti-Libanus. These ridges, throughout their whole extent, from the northern frontier of Palestine to the Dead Sea, are rugged and barren, and destitute of inhabitants. The country between these two chains is watered by the Jordan, which has its rise in the northern chain of the Libanus Mountains, and flows southward in the central valley through the Lakes of Hoole and Tiberias, until it terminates in the Dead Sea. The country has generally been divided into three regions, namely, Judea, which lies to the south, Samaria in the middle, and Galilee on the north; and to these may be added the region beyond the river Jordan, which, running along the whole length of the country, divides it into two distinct portions.

Judea proper contains the modern district of Gaza, and was formerly the central district of the ancient kingdom of Judah, of which it contained the metropolis. It comprehends the whole country from the Lake of Asphaltites to the sea, a space of about sixty or seventy miles in breadth. The soil consists of a sandy earth; and it rises in far-ascending terraces from the sea to the mountains. The country situated near the Mediterranean consists of low plains, that are both beautiful and fertile. The plain around Rama, says Dr Clarke, is as fertile as any part of the Holy Land. It resembles a continual garden; though at the time that this celebrated traveller passed through the country, cultivation had been neglected, owing to a dreadful plague by which it had been visited.[3] The seashore is lined with mastic trees, palms, and prickly pears. The plains, though neglected, are clothed with the richest vegetation; and Sandys describes the country on the coast between Jaffa and Gaza as luxuriant and beautiful. "We

[1] See Relation of a Journey, in four books, containing a description of the Turkish Empire, Egypt, the Holy Land, &c. b. iii. p. 141.
[2] Travels in Palestine, by J. S. Buckingham, vol. ii. chap. xix. p. 118.
[3] Clarke's Travels in the Holy Land, vol. ii. chap. xviii. p. 637.

Palestine. past this day," he observes, "thorow the most pleasant and pregnant valley that ever eye beheld. On the right hand a ridge of mountains, whereon stands Hebron; on the left the Mediterranean Sea, bordered with continued hills, beset with variety of fruits, as they are for the most part of this day's journey. The champaign betweene about twenty miles over, full of flowrie hills ascending leisurely, and not much surmounting their ranker vallies, with groves of olives and other fruites dispersedly adorned."[1] In his journey southward along the coast to Rama and Joppa, he met with the same luxuriant country. The caravan, he mentions, lay in deep pastures, without controlment of the villagers; and descending through different valleys, having "divers orchards," towards the sea, he found a want of trees, but no part barren; and the country, he adds, "would prove more profitable if planted with vines and fruites." Higher up, the country becomes uneven and rocky, and so difficult is the road over rugged and pathless rocks, that though the journey between Jerusalem and Jaffa might be performed in thirteen hours, the distance not being more than forty miles, it generally occupies about a day and a half. The mountains consist of limestone, naked and barren, compared by Dr Clarke to the worst parts of the Apennines, which, however varied, have nothing either of the grand or the picturesque in their appearance. Yet however barren the hills in this district, the intervening valleys are remarkably fertile, and repay the labour of the cultivator by plentiful crops of tobacco, wheat, barley, Indian millet, melons, vines, olives, pumpkins, and cucumbers; while natural groves arise, consisting of the ever-green oak, the cypress, of andrachnes and turpentine trees; and the ground is covered with the rosemary, the cytasus, and the hyacinth. Of these valleys, that of Jeremiah and the Terebinthine Vale are remarkable; the latter famous in sacred history, as the scene of David's triumph over the Philistine. The entrance into this vale is over hills and rocks; the mountain is still seen on the one side, and the mountain on the other, exactly as it is described in holy writ; and the valley between them, and the very brook in which David "chose those five smooth stones," with one of which he smote the Philistine, and which has furnished drink to many a thirsty pilgrim, on his journey from Jaffa to Jerusalem.[2]

The vegetation of these mountains has been compared, for its richness, to that of Crete or Candia. Such is the spreading luxuriance of the forest, that travellers have reposed or dined under the shade of lemon-trees as large as one of the finest European oaks; and sycamores are to be seen, whose expanding foliage is sufficient to afford shelter to a band of twenty or thirty travellers, with their horses. Dr Clarke, in describing his journey to Jerusalem from the north, celebrates in the highest strains the beauty and fertility of the mountainous country through which he travelled. The road, he observes, was mountainous and rocky, and full of loose stones; yet the cultivation, he adds, is even marvellous, and affords one of the most striking examples of human industry that can be anywhere seen. "The limestone rocks," he continues, "and stony valleys of Judea, were entirely covered with plantations of figs, vines, and olive-trees; not a single spot was neglected. The hills, from their bases to their upmost summits, were covered with gardens; all of these were entirely free from weeds, and in the highest state of agricultural perfection. Even the sides of the most barren mountains had been rendered fertile by being divided into terraces, like steps rising one above another, whereon soil had been accumulated with astonishing labour. Amongst the standing crops we noticed millet, cotton, linseed, and tobacco, and occasionally small fields of barley. In places where the ground is subjected to irrigation, two crops are produced, one of wheat in May, and another of pulse in autumn."[3] In many districts fine wines are produced; that of St John, near Bethlehem, is said to be delicious. On the eastern declivity of the central mountains, as they decline into the valley of the Jordan near Jericho, the olives are produced of a large size, which give oil of the finest quality. The mulberry grows in straight rows in the open field, intermingled with the vine, which, hanging in festoons from the branches, presents a graceful appearance; and several of the fruit-trees are continually bearing flowers and fruit in all their stages. This luxuriant vegetation may occasionally languish or be burnt up during the extreme heats and droughts of summer; and at all seasons it is liable to be interrupted, and is only seen in detached spots in more lofty situations; but these exceptions to the general luxuriance of the scene may partly be ascribed to the heat and drought of the climate, and partly also to the indolence and general barbarism of the country. It is certain, that the more deeply we penetrate into these hills, the rugged nature of the scenery and the barrenness of the country increases, and, "as we approach the centre of Judea," says M. Chateaubriand, "the sides of the mountains enlarge, and assume an aspect at once more grand and barren; by little and little the vegetation languishes and dies; even mosses disappear; and a red and burning hue succeeds to the whiteness of the rocks. In the centre of the mountains there is an arid basin, enclosed on all sides with yellow pebble-covered summits, which afford a single opening to the east, through which the surface of the Dead Sea, and the distant hills of Arabia, present themselves to the eye. In the midst of this country of stones, encircled by a wall, we perceive extensive ruins, scanty cypresses, bushes of the aloe and prickly pear; some Arabian huts resembling white-washed sepulchres are spread over heaps of ruins. This spot is Jerusalem."[4] From the central chain of mountains in Judea a desert extends eastward to the Dead Sea, which is encompassed by two rugged chains of sterile hills. North-eastward, the large and fertile valley of the Jordan, called El Gor, has in all ages been celebrated for its rare and valuable productions. It is described by Josephus as the most fruitful country of Judea, in which numerous palm-trees flourished near the town of Jericho, besides the balsam-tree, which was considered as one of the great staples of the country, and the source of its wealth. All these fine productions, by which in ancient times the country was enriched, have now entirely disappeared; and in the vicinity of Jericho there is not a tree of any description, either of palm or balsam, and scarcely any verdure or bushes, to be seen about the site of this city, which is in ruins, and surrounded with desolation. This is ascribed, however, by Mr Buckingham, more to the neglect of agriculture, and of the ancient aqueducts which were constructed for the irrigation of the land, than to any change in the climate or soil. There are traces in many parts of Judea, of ancient and more extended, as well as more skilful cultivation, such as the remains of walls, which were built to support the soil on the declivities of the hills; also of cisterns, in which the rain-water was collected, and afterwards distributed in canals over the fields. In a hot and dry climate, and a rocky country, water is a main ingredient of fertility; and under an ardent sun a prodigious produce must have been extracted, by means of this artificial irrigation, from the thirsty soil. All the ancient accounts of Judea, accordingly, agree in describing it as a rich,

[1] Sandys, lib. iii. p. 150.

[2] 1st Sam. xvii. 2, 3; Clarke's Travels in the Holy Land, vol. ii. chap. xviii. p. 625.

[3] Clarke's Travels in the Holy Land, vol. ii. p. 520.

[4] Travels in Palestine, vol. ii. chap. xvii. p. 70.

productive, and well-cultivated country; and, under all the ruthless desolations of war and barbarism to which it has been exposed, it still retains the traces of careful cultivation. It still answers to its ancient character of a land flowing with milk and honey; the flocks of the Arabs finding here luxuriant pastures, and the wild bees still lodging in the holes of the rocks, where they lay up their stores of fragrant honey, that is seen flowing from them.

Every spot in Judea is consecrated by ancient recollections, and has been the scene of some great event in sacred history. Jerusalem, the capital, has been already described under its proper title, and is still a remarkable city, though declined from its ancient splendour. The other towns are Bethlehem, the birthplace of our Saviour, about six miles to the south of Jerusalem, renowned for its antiquity, and for the localities consecrated by the Redeemer's presence; and especially for an elegant church, on the supposed site of the sacred manger, enriched by offerings from all the nations in Europe. It contains from 1000 to 1500 inhabitants, mostly Christian. Hebron is still farther to the south, in a less arid country, with 1000 or 1200 inhabitants. This ancient city, the seat of David's kingdom before he took Zion from the Jebusites, is entirely in ruins. Gaza, famous as the scene of Samson's exploits, is situated near the sea-coast, on a hill in the midst of valleys, and these again surrounded with hills planted with all sorts of delicate fruits. It has now declined, like all the other cities in this country, from its ancient importance; the buildings, says Sandys,[1] being "mean, both for form and matter; some built of mud; among all, not any comely or convenient;" "yet," he continues, "even there some relicks left that testifie a better condition. For divers simple roofs are supported with goodly pillars of Parian marble; some plaine, some curiously carved. A number broken in pieces, do serve for thresholds, jambs of doors, and sides of windows, unto every beggarly cottage." Ten miles north of Gaza, on the sea-coast, stands Ascalon, celebrated during the Crusades, but now a place of no note. Azotus and Acheron, also on the coast, are places of no account; and Rama, about thirty miles north-west of Jerusalem (not the city to which the prophecy of Jeremiah applies, "In Rama was a voice heard," &c.), a magnificent city during the time of the Crusades, was found by Dr Clarke to exhibit one scene of ruin. This was no doubt partly occasioned by the plague, which had raged in Judea previous to his visit, but partly also to the general tendency to decline and ruin, which is seen throughout the whole country, from the indolence and barbarism of the inhabitants, and the oppressions to which they are exposed. The remarks of Sandys on the incongruities seen in the buildings at Gaza, of marble pillars in the meanest structures, apply generally to the towns throughout the Holy Land; all of which, however mean in their present appearance, bear the marks of former magnificence, and of a happier era. About ten miles to the west is situated the town of Joppa or Jaffa, which owes all its celebrity and importance to its being the port of Jerusalem, being one of the worst harbours in the Mediterranean. It was in ancient times the only port in Judea, to which, from Mount Libanus, were brought the materials for building the temple of Solomon, previous to their being transported by land to Jerusalem. To the north of Jerusalem, on the western slope of the central mountains as they decline into the valley of the Jordan, stood the ancient city of Jericho, now a scene of ruin, so that the site of this city is scarcely known; and Buckingham, one of the latest and most judicious as well as learned travellers, is of opinion that it has been fixed too near the river Jordan, at Rihhah. In a spot near to this he discovered heaps of ruins, the position of which seemed to agree more accurately with the site assigned to Jericho by Josephus than any other in the country.

To the north of Judea lies the country of Samaria, which is the middle division of Palestine, and is now chiefly comprehended in the district of Naplous. This district of the country is, like Judea, mountainous in the interior; but along the sea-shore extends the plain of Sharon, from Mount Carmel on the north, with little interruption, according to Chateaubriand, into Judea, as far south along the shore as Gaza. But this space comprises, properly speaking, four distinct plains, separated from each other by ridges covered with loose stones. The soil of the plains in Samaria, though it is sandy in its nature, is of extreme fertility. It is covered during the spring with many varieties of luxuriant flowers, with white and red roses, with the narcissus, the lily white and yellow, and other beautiful and fragrant flowers and shrubs. Dr Clarke mentions, that he observed the *cactus ficus Indicus* growing to an enormous size, its gaudy blossoms making a splendid show, and concealing the thorns under them, that inflict severe and even dangerous wounds in this climate.[2] This fertile soil, according to Chateaubriand, languishing under the iron rod of Turkish despotism, produces nothing but thistles, dry and withered grass, mixed with inconsiderable plantations of cotton, millet, and grain. The condition of the country, no doubt, depends on the character of the Turkish pasha, to whose care it is committed; and the fairest promise of prosperity is frequently blighted by the misrule of a cruel and avaricious tyrant. Such was Djezzar Pasha, who ruled the pachalik of Acre at the time Dr Clarke visited the Holy Land; and who, by his cruelty and extortion, converted a fertile district into a desert. But the country that was under the milder rule of the pasha of Damascus bore an entirely different appearance; and Dr Clarke observes, "cultivated fields, gardens, and cheerful countenances, exhibited a striking contrast to the territories of Djezzar Pasha, where all was desolation, war, and gloominess." Mr Buckingham, however, ascribes this improved aspect of the country less to the influence of the government, than to the difference in the respective characters of the inhabitants of the hill country and the plain. At the later period, when he visited this district, it was ruled by the pasha of Acre, with benevolence and equity; and in the interval that had elapsed from the death of Djezzar, the country might have recovered from the effects of his violence and tyranny. The peasant will not cultivate where he is not sure of reaping the fruit, and, under the extortions of such a tyrant as Djezzar, the most fertile country may languish and decay. But the young corn and verdant spots, seen by Mr Buckingham, even to the mountain top, attest a flourishing state of agriculture scarcely consistent with the barbarous oppression of the former pasha, seeing that the effects of such tyranny are permanent; debasing, as it does, the habits of the people, and fostering an indolence and apathy that paves the way for the desolation of the country. Of the aspect of Samaria Mr Buckingham generally observes, that the face of the country so far resembles Judea, that both are composed of abrupt and rugged hills, differing essentially from the plains of Galilee. But the country of Palestine seems to deteriorate towards the south; it assumes a more bold, mountainous, and rugged appearance, and contains a much larger proportion of arid soil. Thus, in Judea, the hills are mostly completely bare, and it is only the narrow intervening valleys that are fertile; in Samaria, on the other hand, the hills are clothed to the summits with vegetation. These, adds this enterprising and judicious traveller, with the luxuriant valleys which they enclose, pre-

[1] Lib. iii. p. 149.

[2] Travels in the Holy Land, vol. ii. chap. xv. p. 502.

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sent scenes of unbroken verdure in almost every point of view, which are delightfully variegated by the picturesque forms of the hills and vales themselves, enriched by the occasional sight of wood and water, in clusters of olive and other trees, and rills and torrents running among them.[1]

Samaria is divided from the northern province of Galilee by the river Kishon, or by the natural boundary of high ground, about six or eight miles nearly north and south, coming from the plain of Esdraelon, and terminating in the lofty promontory of Mount Carmel, famed of old for its beauty and luxuriant vegetation, and still bearing its native cedars and wild vines and olives, intermixed with brambles, as memorials of its ancient fertility and more careful cultivation, but, in general, consisting of barren and desolate rocks formed of a whitish stone, with flints imbedded in it. Sandys describes it as "rich in olives and vines, when husbanded, and abounding with several sorts of fruits and herbs both medicinal and fragrant, though now overgroune with woods and shrubs of sweet savour."[2] It has, towards the east, the fine plain watered by the Kishon, which flows past its base into the sea; and on the west, a narrower plain descending to the Mediterranean. It does not exceed 1500 feet in height. During the middle ages this mountain was filled with grottos, cut out of the rock, the abode of numerous monks, who, from this mountain, took the name of Carmelites. To each monastery a chapel and little garden were attached, so that the mountain was entirely covered with them. Mr Buckingham mentions that he saw several of these grottos, all small and rude; and a little below, he came to a sort of caravanserai, built before a fine cave, into which he entered, and found a well-hewn chamber cut entirely out of the rock, and squared with great care, being twenty paces long, twelve broad, and from fifteen to eighteen high. It forms a considerable halt for travellers, as it affords good shelter, and contains a cistern of excellent water. Pococke also mentions one of these grottos near the foot of the hill, "which," he adds, "is one of the finest I ever saw; it is like a grand saloon, and is about forty feet long, twenty wide, and fifteen high; it is cut out of the rock, and is now converted into a mosque."[3] The heights of Carmel enjoy a pure and enlivening atmosphere, while, in the interior, the sky is often obscured by fogs; and from the top of the mountain is an extensive prospect of the Mediterranean to the west, the snowy heights of Lebanon towering above the summits of the other mountains on the east, with Acre and the adjacent fertile plains. On the summit formerly stood the monastery which was for a long period the head-quarters of the Carmelite friars, and which is said to have been built near the spot where Elias offered up sacrifices. This monastery, which was not a fine building, is now entirely abandoned, and the monk who has charge of it lives in the town of Caypha, below. It was used as an hospital by the French during their campaign in Egypt, for which its retired and healthy situation, and its interior structure, well adapted it. It has been since greatly injured by the barbarous Turks; its altars have been stripped, and its roofs beaten in, though there still remains, for the edification of devout visitors, a small stone altar, in a grotto dedicated to St Elias, over which a coarse painting is seen of the prophet leaning on a wheel, with fire, and the other symbols of sacrifice beside him. There are few towns of any note in this once flourishing, but now comparatively desolate country. The chief town, however, Nablous or Napolose, Neapolis in the days of Herod, and the ancient Sichem, seems still to be, according to the account of Dr Clarke, the metropolis of a rich and extensive country, abounding in provisions, and all the necessaries of life. The white bread exposed for sale here on the streets is far superior to any seen elsewhere in the country. The inhabitants are industrious, and the manufactures of the town, of which soap is the principal, supply a very widely extended neighbourhood. The town is described as being embosomed in the most delightful and fragrant bowers; half concealed by rich gardens, and by stately trees collected into groves, all around the bold and beautiful valley in which it stands.[4]

Sebaste, the ancient Samaria, the capital of the country, is now a village consisting of a few humble dwellings in the midst of magnificent ruins. This place was famous in the ancient Jewish history, and is mentioned as a city of importance by the Roman historians, and also by Josephus. It escaped the notice of Dr Clarke, though he passed near it, and he accordingly mistakes the castle of Sanhoor, or Santorni, for the site of this ancient metropolis. But its ruins are described at length by Buckingham. He saw the remains of one large street, consisting of eighty-three columns erect, and of others which had fallen, but all of them without capitals. On the eastern side of the hill on which the city stood, eight large and eight small columns are still standing, with many others lying near them, and blocks of stone and fallen pillars scattered on the adjacent ground; and in the humble walls of the houses that form the modern village, portions of sculptured blocks of stone are perceived, and even fragments of granite pillars, worked into the masonry, while other remains of former and more magnificent edifices are seen scattered around. The most conspicuous object that still remains at St Sebaste, is a large cathedral, now in ruins, attributed to the piety of the Empress St Helena. It is about a hundred feet in length by fifty in breadth, the northern wall quite plain; the eastern front semicircular, with three open and two closed windows, each contained in arches divided from each other by three Corinthian columns.[5] Most of the other towns here, as well as in Judea, exhibit marks of ruin, amid the memorials of ancient magnificence. The small village of Jennin, about twenty-five miles to the north, contains the ruins of a palace and of a mosque, with marble pillars, fountains, and even piazzas in a perfect state; and the ancient Cesarea, on the sea-coast, is now a scene of ruin, where fragments of fine marble pillars, and of ruined houses, are seen strewed on the ground, which is overgrown with briars and thistles, and the haunt of wild boars, which abound in the neighbouring plain.[6] Tortura is merely a small village on the coast, for large boats which are forced to put in here by stress of weather. It is generally supposed to be the ancient Dora.

To the north of Samaria is the district of Galilee, celebrated as the scene of many interesting incidents in sacred history. This province, though still hilly, contains a much greater proportion of champaign country than either Samaria or Judea; and its extensive plains have been celebrated by all travellers for their beauty and fertility. The delightful plain of Zabulon is described by Dr Clarke as being everywhere covered with spontaneous vegetation, flourishing in the wildest exuberance; as delightful as the rich vales in the south of the Crimea, and resembling the finest parts of Kent and Surrey.[7] The soil, although stony, is exceedingly rich, and well adapted for wheat, as well as for the olive, the vine, and other delicious fruits. The grapes excel so much both in size and flavour, that a cluster of them furnishes out the simple supper of a large family. Maundrell describes these plains as being eminently fertile, well watered, and containing every thing else that can render it pleasant and fertile;

[1] Buckingham's Travels in Palestine, vol. ii. p. 390.
[2] Lib. iii. p. 203.
[3] Pococke's Travels, vol. ii. p. 56.
[4] Ibid. vol. ii. p. 507.
[5] Pococke, vol. ii. p. 417.
[6] Ibid. p. 59.
[7] Travels in the Holy Land, vol. ii. chap. xiii. p. 400.

Palestine. but at the same time desolate for want of culture, and overgrown with weeds as high as the horses' backs.[1] Yet amidst this fertility there are tracts of limestone hills, which present one unbroken scene of sterility as far as the eye can reach. Buckingham mentions that he passed over a ridge of these barren hills in his approach to Nazareth from Acre, and that in most parts the hill was so steep and rugged, that he and his fellow-traveller were forced to descend it on foot. It is by these ridges, hills, or rocks, bare and barren, that the fertile plains of Palestine are separated from each other. Southward from Nazareth, which is situated on a range of rocky hills, extends the fertile and celebrated plain of Esdraelon, which is about two days' journey in length and twenty-one miles in breadth. This plain is covered with a fine red soil; it is the most fertile portion of all the land of Canaan; and though a solitude, lying waste, excepting only a few patches ploughed for cultivation towards its southern edge, it is one vast meadow, covered with the richest pasture, where formerly the tribe of Issachar rejoiced in their tents, and over which now range the wandering Arab tribes, around whose dark-brown tents the flocks are seen to gambol to the sound of the reed, which at night-fall recalls them to their home. The plain of Galilee is almost a continuation of the plain of Esdraelon, and appeared, according to the view that Buckingham had of it from Mount Tabor, to be highly cultivated throughout. The plain of Esdraelon, the plain of Megiddo, the Galilean plain, or the great plain as it is often called by way of distinction, has been from the most ancient times the arena on which hostile armies have contended for the dominion of Palestine. Here it was that Barak, descending with his ten thousand chariots from Mount Tabor, discomfited the host of Sisera; here it was that Josiah fought in disguise against Necho king of Egypt, and was slain by the arrows of the Egyptians; and here it was that the Romans arrayed their hostile squadrons for the conquest of the country. "It has been," observes Dr Clarke, "a chosen place of encampment in every contest carried on in this country, from the days of Nabuchadonozor, king of the Assyrians (in the history of whose war with Arphaxad it is mentioned as the great plain of Esdrelom), until the disastrous march of Napoleon Bonaparte from Egypt into Syria. Jews, Gentiles, Saracens, Christians, Frenchmen, Egyptians, Persians, Druses, Turks, and Arabs, warriors out of every nation under heaven, have pitched their tents upon the plain of Esdraelon, and have beheld the various banners of their nations wet with the dews of Thabor and Hermon."[2]

These two latter hills or mounts are often mentioned in sacred history. They are not so remarkable for their height as for their steep ascent from the adjacent ground. Mount Tabor, which rises abruptly from the plain of Esdraelon, is the last to the eastward of a range of four hills of a similar form, but less elevated, and less insulated from the neighbouring hills, and all having passes between them. Its height is 1000 feet, and it is a rounded hill of a globular shape, having its outlines smooth, and its breadth at the base greater than its height. It is clothed, for about one-fourth part upwards, with numerous luxuriant trees and thickets; and the top is an oval plain about a quarter of a mile long, covered with a fertile soil on the west, and having at its eastern end a mass of ruins, seemingly of churches, grottos, strong walls, and fortifications, all of some antiquity, though not of a remote age. These remains here, as in every other part of the Holy Land, afford subjects for monkish fables; and in this manner every remarkable spot in the country is converted into the scene of some memorable incident in holy writ. Here are three grottos, pointed out as the remains of the three tabernacles proposed to be erected by Peter at the time of the transfiguration. In one of these grottos there is a square stone used as an altar; and the night of the sixth August is held as a great festival by all the friars from the convent of St Nazareth, who come with their banners and their host to say mass, accompanied by the catholics in the neighbourhood, and spend the night in festivity, lighting huge bonfires, the wood on the mountains being taken for fuel, and its southern side being in consequence nearly denuded of all the trees which formerly clothed it. There are other scriptural references to Mount Tabor. It was towards this mount that Barak was commanded to draw his forces when he went to meet the host of Sisera; and it seems to have been, in after ages, considered as a good position, as it was, during the invasion of Judea by the Romans, encompassed with a wall, and occupied as a military post when the Jews were besieged by Placidus, the lieutenant of Vespasian. There is also a vague tradition of a city built on the top, which sustained a five years' siege; and it is certain that it was formerly a place of great strength; and when it lost this warlike character, it became a sanctuary; so that ancient remains, religious as well as warlike, now mingle on its summit in one common ruin. Hermon, about six miles distant, rises from that range of hills which bounds the great plain of Esdraelon on the south. Its lofty peak condenses the vapours of the atmosphere, which descend in copious dews, and produce the most luxuriant vegetation, while the surrounding country is parched with drought; so that this renowned mount completely answers to all the scriptural allusions concerning its fertility and verdure, and the refreshing dews by which it is watered, and which in this country are so profuse as to compensate the long drought, and supply the place of rain.

Galilee is remarkable as the scene of our Saviour's first preaching and miracles, and its towns and villages are associated with many interesting events of Scripture history. Nazareth contains about 2000 inhabitants, consisting of Catholic Christians, Maronites, Mahommedans, and schismatic Greeks. The Maronite church is built over a grotto, held sacred as the supposed scene of the angel's annunciation to Mary, of her conception and birth of the Saviour. There is another grotto, with two red granite pillars about two feet in diameter at its entrance, one of which is said to mark the spot where the virgin rested, and the other where the angel stood when he intimated to Mary her favour with the Lord. The grotto, though only about eight feet in height, still remains in its original roughness, the roof being slightly arched. Every spot here has its absurd legend, the credit of which the friars are interested to maintain. The chimney of the hearth is shown on which Mary warmed the food for her infant son, and where she baked cakes for her husband; also the apartment in which her son lived in subjection to his parents; and Buckingham is of opinion that this last tradition is nowise improbable, as excavated buildings in the side of steep hills, such as the one he describes, are more secure and more permanent than others, and as it is known that Joseph and Mary dwelt in this place, where they reared their son. There is no evidence however to prove, that though they dwelt at Nazareth, this house was their residence, farther than the most vague tradition; and Dr Clarke seems to consider, with much appearance of reason, all these legends as inventions of the superstitious and ignorant monks, in order to maintain the reputation of these holy places. The synagogue in which Christ read and expounded the prophet Esaias is shown within the town; and, more than a mile distant to the southward, the precipice is pointed out from which the Jews, offended with his doctrine, would

[1] Maundrell, p. 52.

[2] Travels in the Holy Land, chap. xv. p. 499.

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have cast him headlong. Not many miles to the east of Nazareth is Cana of Galilee, where our Saviour performed his first miracle of changing the water into wine; and about a quarter of a mile from the village there is a delicious spring of clear water, whence the village is supplied and whence was drawn the water which was made wine. Cana is a small village, containing the ruins of a church, erected, according to tradition, on the spot where the marriage-feast of Cana was held; and among these ruins Dr Clarke remarked, that there were large massy stone water-pots, the vessels commonly in use in the country, and answering the description of those used of old by the Jews. About three miles from Cana is the village of Turan, in a field, where they assert that the disciples plucked the ears of corn on the Sabbath-day, and from which the pious devotees from Italy still gather the stalks of wheat as relics to carry back to their own country. From nine to twelve miles north-north-east stands the town of Tiberias, along the edge of the lake of that name. It has all the showy appearance of a Turkish citadel from without, which is sadly contrasted with its wretchedness within; it is supposed to be the Chemeroth of the Hebrews. No antiquities now remain except an ancient church, constructed during the fourth century. Two or three miles southward from the town are warm baths, that have been long in great repute. A small and mean building has been erected over them by the Mahommedans. Extensive ruins are scattered around, supposed to be the remains of Roman edifices. Of the other ancient cities of Galilee, Capernaum, now called Talherom or Tel Hoom, situated about ten miles in a north-easterly direction from the lake of Tiberias, formerly a place of importance, is now reduced to a station for the wandering Arabs. As is the case, however, with the other towns of Judea, the memorials of former magnificence lie scattered around. The traces of a magnificent building are still to be seen, though its ruin is so complete that its character can no longer be ascertained. The whole space within its extensive walls is covered with blocks of sculptured stone, in friezes, cornices, and mouldings. Bethsaida, also near the Lake of Tiberias, and which was enlarged and embellished by Herod, is so entirely ruined that no traces remain to mark out the site of its walls, or of its temples or palaces. Acre, the Accho of the Scriptures, and one of the strongholds from which the Israelites were not able to dislodge the Canaanites, is celebrated for the bloody conflicts of which it was the scene during the crusading wars, and in modern times for its gallant defence against the victorious legions of Bonaparte. It is situated on the extremity of a plain, at the bottom of the bay of Acre, formed by the promontory of Mount Carmel on the south-west, and the skirts of the plain itself on the north-east, and about ten miles across. A particular description of Acre will be found under its proper title; and we may only add, that Mr Buckingham, in his visit to this town, thought that he discovered the Canaanitish remains of the ancient city of Accho. The workmen were sinking a ditch to surround the outer wall, to the depth of twenty feet below the level of the soil; by which the foundations of very old buildings were exposed to view, constructed of such materials as marked beyond a doubt a very high antiquity; being a "highly burned brick, with a mixture of cement and sand, as well as small portions of stone in some parts, the whole so firmly bound together by age, and the strongly adhesive power of the cement, as to form one solid mass."[1]

Mountains.

Judea is intersected throughout its whole length by a ridge of mountains, from which other and lesser branches diverge, and overspread the whole country. These mountains are a prolongation of the Syrian chain, which begins on the south of Antioch, with the huge peak of Caprus, shooting up to the heavens, its needle-like point encircled with forests. This chain, on entering Judea, follows the shores of the Mediterranean, from which it is not above twenty or thirty miles distant. Mount Libanus, which is within the line of perpetual snow, is its highest summit. This ridge divides itself into two, namely, that of Lebanon, which overlooks the Mediterranean, and another chain, called Anti-Libanus, which looks eastward over the Syrian desert. This chain must be of very great height, as its snowy summits were seen by Dr Clarke in his journey from Nazareth to Tiberias, towering beyond a series of intervening mountains with unspeakable greatness. He considered these mountains as part of the chain of Lebanon, though the Arabs who accompanied him described them as part of the Anti-Libanus chain, near Damascus. "The summit," says Dr Clarke, "was so lofty that the snow entirely covered the upper part of it; not lying in patches, as I have seen it during summer upon the tops of very elevated mountains, as on Bennevis in Scotland, but investing all the higher parts with that perfect white and smooth velvet-like appearance which snow only exhibits when it is very deep; a striking spectacle in such a climate, where the beholder, seeking protection from a burning sun, considers the firmament to be on fire."[2] Lebanon is still covered with tall cedars, and in ascending its sloping sides, all the varieties of a European climate are experienced, with a corresponding variety of vegetable produce. The ground is enriched with thousands of rare plants, and beautiful and fragrant flowers; the primrose of Libanus, the mountain amaryllis, mingling their brilliant hues with the verdure of the birch-leaved cherry. Not only the summits, but the higher valleys, are covered with perpetual snow. At a lower level, a perennial verdure is maintained, by the humidity and coolness of the atmosphere, and the good quality of the soil; and it is pleasing to remark, in these higher regions, where industry is here less harassed by the predatory inroads of the Arabs, that the country exhibits a flourishing appearance; and we here behold those ingeniously contrived terraces, which preserve the fertile earth; well planted vineyards, which produce the finest wines; fields of wheat; plantations of cotton, of olives, and of mulberries, which in the midst of rocky steeps, present the pleasing picture of successful industry. These mountains are chiefly composed of limestone rocks, and abound in those ores which are common in Palestine, and are characteristic of that formation.

Rivers and lakes.

The deep ravines of these mountains are watered by numerous streams, which arise on all sides in great abundance. But the principal river of Palestine is the Jordan, which has its rise in the range of Libanus, and, running from north to south, intersects the whole country of Palestine. It forms the small lake of Hoole, and enters the great lake called the Sea of Tiberias, from the southern extremity of which it again issues. Flowing southward through an extensive plain, it passes Jericho to the east, and falls into the Dead Sea or Lake of Asphaltites. The Lake of Tiberias at Gennesareth is twelve or sixteen miles in length from north to south, and in breadth seems to be from six to nine miles. The surrounding scenery is of no common grandeur, the lake is surrounded by precipitous hills, which shelter it from the tempest. Yet it is occasionally liable to dangerous storms, because, when the wind blows violently, it strikes down perpendicularly on the surface, and ploughs it up into the most frightful inequalities. It was in one of these storms that the disciples of our Saviour, who had embarked in one of the small vessels that traverse the lake, were in danger of perishing, when they saw Jesus, about the fourth watch of the night, walking up-

[1] Travels in Palestine, vol. i. p. 116.

[2] Travels in the Holy Land, vol. ii. chap. xiv. p. 456.

Palestine. on the waves. The barrenness of the surrounding mountains, and the total absence of wood, give an aspect of dulness to the scenery; and this impression is heightened by the dead calm and the silence which reigns over the wide expanse of its waters, where not a boat or vessel of any kind is to be seen. The Lake Asphaltites, or the Dead Sea, in which the Jordan terminates, is sixty or seventy miles in length by ten or twelve in breadth. This lake is slightly curved in the form of a bow, sunk between two ranges of mountains, which have no resemblance of form, nor any common properties of soil. It is surrounded, like the Lake of Tiberias, by lofty and barren mountains; and is also remarkable for the death-like stillness of its waters. The surrounding scenery is represented as being in the highest degree grand and awful; and its desolate aspect is well adapted to the marvellous tales which are told of its malignant influence. The waters of this lake were formerly believed to be destructive of animal life, so that no fishes could live in them; that birds flying across were killed by the pestilential exhalations from its surface; that heavy bodies were buoyed up by the specific gravity of its waters; and, finally, a singular species of fruit, called the apples of Sodom, was said to be produced on its shores, which was beautiful to the eyes, but bitter to the taste, and full of ashes or dust within. All these fables have, however, disappeared before the rational inquiries of modern travellers. It is now known, that the supposed deadly waters of this lake swarm with myriads of fishes; that flocks of swallows are seen constantly skimming along its surface; that the absence of other birds arises from the want of vegetable food in the adjacent rocks or barren plains; and that the mysterious fruit found on its shores is as natural as any other vegetable production. Respecting this fruit various theories have prevailed. Tacitus and Josephus are the first authors who mention its singular properties; other authors, describing this fruit as an emblem of worldly pleasures, fair without, but full of rottenness within, gave a romantic and fabulous cast to the story; so that subsequent travellers, such as Pococke and Shaw, doubted the existence of any such production. Hasselquist, however, the botanist, described it as the fruit of the *Solanum melongena*, found in abundance near the Dead Sea, of which the fruit, when attacked, turns to dust, the skin only remaining entire, and of a beautiful colour. M. Seetzen thought that he discovered the fruit called the apple of Sodom, which contained within a sort of cotton resembling silk; while Chateaubriand describes it as growing on a shrub which he found everywhere within three leagues of the mouth of the Jordan. Before it is ripe it is filled with a corrosive and saline juice; and when dried it contains a blackish seed, that may be compared to ashes, and which has the taste of a bitter powder.[1] The water of this lake is of greater specific gravity than any other known, and is remarkably buoyant. Its specific gravity is 1·211, while that of fresh water is 1000. It is impregnated with a mixture of different saline substances; such as lime, magnesia, soda, sulphate of lime; and the taste is a compound of salt and bitter, extremely offensive.

Plain of Jordan. The valley of the Jordan is a marked feature in the scenery of Judea. It is situated between the lofty and central range of mountains on the west, which rise to the height of from 1500 to 2000 feet, and the range of the Arabian mountains on the east, the height of which does not exceed 1000 feet. Nothing can exceed the forbidden aspect of these western hills; not a blade of verdure is to be seen over their whole extent, nor any sound to be heard; the eastern range is equally barren, except some little dells near the plain, where the rains, being collected, favour vegetation. This is said to be the wilderness in which the Saviour dwelt with wild beasts, while angels ministered to him; and it certainly forms, according to the accounts of all travellers, a most appropriate scene for such an incident. In the mountains are many grottos of the early anchorites, in long ranges, and consisting of separate chambers, now entirely deserted. Here Mr Buckingham observed the remains of a fine Roman aqueduct, consisting of at least twenty arches, and leading from the foot of the mountains, in a direction from west to east, into the valley of Jordan. Here also he fixed the site of the cities of Bethel and Ai, describing the nature of the ground as being extremely favourable for the ambush by which these cities were destroyed. The great plain of Jordan, hemmed in on both sides by mountains, fills up the whole space between the Lake of Tiberias and the Dead Sea, and it is about fifteen miles in breadth. This plain is in some parts unfertile, the soil being covered with a saline incrustation, and having small heaps of a white powder like sulphur scattered at intervals over its surface; in other parts it is more fertile, being covered with a carpet of green. The country that lies beyond the Arabian mountains on the east of the valley of Jordan, is a sort of table-land, though still diversified in its surface: it is a fine country, of an entirely different aspect from the bare mountains of Judea, and rivalling in fertility and picturesque beauty the celebrated plains of Zabulon and Esdraelon in Galilee and Samaria. Mr Buckingham describes with equal delight and admiration the varied beauties of this romantic region, the Decapolis of the Romans, the seat of ten renowned cities, famed for wealth and refinement, but now a scene of desolation, over which the wild Arab ranges with his flocks in quest of pasture or of prey. The country, according to the account of this traveller, is of extraordinary richness, abounding in the most beautiful prospects of thick forests, verdant slopes, and extensive plains. The landscape alone varied at every turn, and gave new beauties from every different point of view. "The general face of this region," he adds, "improved as we advanced farther into it; and every new direction of our path opened upon us views which surprised and charmed us by their grandeur and their beauty. Lofty mountains gave an outline of the most magnificent character; flowing beds of secondary hills softened the romantic wildness of the picture; gentle slopes, clothed with wood, gave a rich variety of tints hardly to be imitated by the pencil; deep valleys, filled with murmuring streams and verdant meadows, offered all the luxuriance of cultivation; and herds and flocks gave life and animation to scenes as grand, as beautiful, and as highly picturesque, as the genius or taste of a Claude could either invent or desire." This district of Bothin, or the ancient Battanea, is distinguished by numerous caverns hollowed out of the calcareous mountains, which served formerly as the abodes of the ancient inhabitants, and now of the wandering Arabs. It was here that a modern traveller, Dr Seetzen, discovered, in 1816, the ruins of Djerash, the ancient Gerasa, where temples, superb amphitheatres of marble, and hundreds of columns, are still seen, among other splendid remains of its ancient grandeur. The finest object which he met with was a long street bordered on each side with a row of Corinthian columns of marble, and terminating in a semicircular open space surrounded with sixty Ionic columns. This city occupied nearly a square about a mile in length, facing the four cardinal points. It stood on the slopes of two opposite hills. The whole surface of the western hill is covered with temples, theatres, colonnades, and ornamental architecture. The plan of the city was distinctly traced by Mr Buckingham, amid its splendid ruins; the main street intersected by two other streets at right angles,

[1] Chateaubriand, vol. i. p. 413. "J'ai cueilli," he observes, "une démi-douzaine de ces fruits; j'en possède encore quatre dessechés, bien conservés, et qui peuvent mériter l'attention des naturalistes."

Palestine.

in which the Ionic and Corinthian orders prevail. A detailed description of the temple, the theatre, and the other ornamental buildings which are seen at this place, and of which, though in ruin, a large proportion still remains, would be inconsistent with our present limits; and the reader is therefore referred to the work of Mr Buckingham, which contains ample details on the subject.[1] Amman, the ancient Philadelphia, one of the principal cities of Decapolis, presents also very splendid ruins; and to the south, on the eastern shore of the Dead Sea, is found the bleak, barren, and mountainous district of Carac, where are the ruins of Rabboth-Moab, the ancient capital, and formerly a populous and an important place. Farther to the north are found the countries called by the moderns Haouran and Dschaulan, little known until, of late years, they were explored by the travellers Dr Seetzen and Burckhardt. They consist of a vast plain of table-land, stretching southward from Damascus, not watered by any great river, yet rendered fertile by the industry of the inhabitants, who collect the rain-water into ponds for the purpose of irrigation, and thus contrive to raise large crops of grain. Of these countries Haouran is the most celebrated for its luxuriant harvests of wheat; and the undulations of the ripened grain on its extensive fields have been compared to the rolling waves of the ocean. Many hummocks are seen scattered over the plain, the sites generally of deserted villages. All these hummocks, and every stone found in the field, all the building stones, and the whole mountains of Haouran, consist of basalt; and the houses being entirely built of this stone, even to the door-posts, present rather a sombre appearance.

Vegetable produce.

The vegetable products of Palestine have been partly described in the preceding sketch of the country. On the fertile plains of Galilee and Samaria, as well as in the valleys among the hills, are produced abundant crops of grain, namely, wheat, rye, barley, Indian millet, also cotton, linseed, and tobacco, while the limestone rocks and stony valleys are clothed with plantations of the fig, the vine, and the olive trees; pumpkins, cucumbers, and melons are also produced in great abundance and perfection. The water-melons, especially, which are produced at Joppa, are celebrated all over the Levant, and are delicious. They are also found at Damietta in Egypt, and seem to owe their flavour to the peculiar soil of these two places; for when they are transplanted, though they be cultivated in the same manner, they lose their exquisite flavour, and quickly degenerate.[2] The orange tree, dates, and bananas, and other delicate fruits, also flourish in Palestine. Sesamum abounds, which affords oil; and the doura, a species of grain similar to that in Egypt. Maize thrives in light soils, and rice on marshy grounds. Indigo grows wild on the banks of the Jordan, and with care and industry might be brought to perfection. The white mulberry forms the riches of the mountain country of the Druses, by means of the beautiful silks which are obtained from it; and the grapes, that grow especially on the mountains of Lebanon, yield red and white wines, which rival those of France or Portugal. Jaffa boasts her lemons and her water-melons, and Gama possesses both the dates of Mecca and the pomegranates of Algiers. Sugar is cultivated in the adjoining country of Syria; and there is little doubt that it might be transplanted with success to the equally congenial soil of Palestine. The coffee shrub from Arabia might also be cultivated with equal success. Palestine produces a variety of forest trees. The sea-shore is lined with mastic trees, palms, and prickly pears. Higher up, the sycamore tree repays the labour of the cultivator, and natural groves arise, of oaks, cypresses, andraches, and turpentine trees. The oaks of Bashan still remain, and Lebanon is crowned with its stately cedars. The ground is covered with shrubs and fragrant flowers; so that the vegetation on the mountains has been compared to that of Ida in Crete.[3] In the desert and rocky places are found scanty cypresses, bushes of the aloe and prickly pear, and a few other thorny shrubs.

Minerals.

Owing to the gross ignorance and the wandering and predatory habits of the inhabitants of Palestine, no inquiries have ever been made into the mineral produce of the country; though there is little doubt but the mountains of Lebanon, if they were explored, would yield mineral ores, and other valuable substances. Rich iron mines are said to exist in the country of the Druses, but whether they are worked with any effect does not seem to be known. Nitre is here abundant, but alum and vitriols are less frequent. The only metal found is iron. The mountains along the shores of the Dead Sea consist of granite; and the country in many parts exhibits traces of a volcanic origin. Mr Buckingham, while crossing the river Hieromax in his journey to Nazareth, observed that the dark masses of rock over which it took its course resembled a stream of cooled lava. The stones of its bed were porous, and on the ground were small patches of sulphur in many places; and he was of opinion that all these, together with the hot springs he had visited, the lakes of Cesarea and Tiberias, the sulphureous and unfertile nature of the plain of Jericho in many parts, and the whole phenomena of the Dead Sea, namely, the bitumen, the lavas, and the pumice, which continue to be thrown ashore by its waves, were sufficient indications of volcanic fires, perhaps on the whole range of the long valley, from near the sources of the Jordan, to beyond the point of its issue in the great Lake of Asphaltites. The hot springs mentioned above were seen and examined by Mr Buckingham. One on the banks of the Hieromax emitted a highly sulphureous odour, and its heat was painful if the hand was immersed in its water beyond a few seconds. In the baths near Tiberias the water had also a slightly sulphureous taste, and was of a light-green colour; though the heat was not much greater than that of the atmosphere, the thermometer, which was at eighty-four degrees, rising when immersed in the water only to eighty-six. The hill from which these baths are supplied consists of a black and brittle sulphureous stone, which is found in the neighbourhood, as well as on the shores of the Dead Sea, and in other parts of the valley in which it is situated. Here also is found a species of limestone called the fetid, and emitting a highly offensive smell. The bitumen that is seen on the shores of this lake, or is collected in the middle of it by boats and rafts, rises from the bottom and floats on the surface.

Climate.

The climate of Palestine varies in different districts, according to the locality and elevation of the ground; and the plains on the sea-shore are subjected to intense heat, accompanied with heavy rains. The plains in the interior, and especially those near Arabia, are subject to drought and to scorching heat; while the Libanus range of mountains, covered with everlasting snow, diffuse a refreshing coolness all around. In these elevated regions the winter, lasting from November to March, is sharp and rigorous. Heavy falls of snow take place every year, and cover the ground to the depth of several feet for months together. The spring and the autumn are mild and agreeable, and the summer is not oppressive. In the plains the heats during summer are most excessive. Dr Clarke mentions, that on the 6th July, at twelve o'clock, Fahrenheit's thermometer, in a gloomy recess under ground, perfectly shaded, stood at 100 degrees. In the course of the same month

[1] Travels in Palestine, vol. ii. chap. xxi.
[2] Richardson's Travels along the Mediterranean, vol. ii. p. 268.
[3] Malte-Brun, vol. ii. p. 150.

Palestine. the thermometer, before noon, in the shadiest place that could be found, stood at 102. During this excessive heat all nature seems to droop, and every animal seeks the shade. But the chameleon, the lizard, the serpent, and all sorts of beetles, bask in the sun, even at noon, on rocks and sandy places, and seem to rejoice under his scorching rays. These overpowering heats commence as soon as the sun has passed the equator, and continue till October. During this season the simoom, or the south wind of the desert, is frequently experienced. In July, Dr Clarke felt the parching influence of this unhealthy wind, which pervaded all places alike, coming as if from a furnace, and producing a feeling of suffocation. He himself was affected with giddiness and burning thirst from the fierce blast; afterwards with headach, frequent fits of shivering; and, finally, with violent fever. These winds continue from one to three days. Easterly gales prevail during the spring and part of the summer. In June variable breezes commence, and blow from all points in the course of a single day. During the autumnal equinox, the north-west, which is a clear, dry, and sharp wind, begins to blow with strength. In November the wind shifts to the west and south-west, which invariably brings on heavy rains; the west wind being called by the Arabs the father of rain. Palestine, from its northern latitude, is without the range of the tropical rains; and has in their stead the early and the latter rains in spring and autumn. These are generally copious, though they sometimes fail, when the country is burnt up with drought. The heaviest rains fall generally in December, which in January spread a covering of verdure over the whole country. But when Mr Buckingham was travelling in Palestine, drought had prevailed from October to January, with only an interval of two or three days' rain; and the whole country had a dry and parched appearance. The winter is so mild in the plains and along the sea-shore, that orange trees, dates, and bananas, and other delicate fruits, flourish in the open field. It is during this season that, contrary to what is observed in other countries, storms of thunder and lightning generally take place, accompanied by heavy showers of rain or large hail-stones. Maundrell mentions, that he met with a severe storm of heavy rain, with terrible lightning and thunder, on the 3d of March, in his journey from Aleppo to Jerusalem.[1]

Animals. An enumeration of the animals which belong to Palestine is given in the sacred volume; but the particular animal to which the Hebrew name applies is often a question among the learned, and hence the zoology of this country may perhaps be best illustrated from the descriptions of modern travellers. Its domestic animals are chiefly those of Europe, with the addition of the buffalo and the camel. Its wild animals are the ounce or the panther, the hyena, the jackall, and, according to some, lions have been seen among the rushes and thickets on the banks of the Jordan. The gazelle or the antelope, supposed to be the roebuck or tzebi of the Hebrews, is seen in flocks bounding over the grassy plains, and is often hunted by the Arabs. The wild boar is also an object of the chase; and on a plain covered with bushes in the vicinity of Mount Carmel, Mr Buckingham saw a party of soldiers in pursuit of a large wild black boar, which still fled from the horsemen, though wounded and streaming with blood. Among the wild and solitary mountains the fallow-deer is to be found; also the wild goat, with horns bending over the back, a foot or fifteen inches in length; and the wild ass, which is found in all the most desolate parts of Asia. Of the ornithology of Palestine we have no very accurate or scientific account. There is, indeed, in the law of Moses an enumeration of the clean and the unclean birds; but great difficulties occur in translating the Hebrew nomenclature into modern language. The most remarkable of the feathered race may, however, be mentioned, such as the eagle, the vulture with the feathered ring round the neck, and from four to five feet in height,[2] the ostrich, the hawk, the kite, the raven, &c.; and of sea-birds, the pelican, the stork, the cormorant, &c. Serpents and other reptiles, quickened into mischievous activity by the heat of the climate, are common in Palestine; and Dr Clarke mentions, that in passing through the streets of Nazareth he perceived a woman issuing hastily from a house, carrying a cradle containing an infant, and frantic with rage and grief. Returning immediately, she was seen beating something violently on the ground, which proved to be an enormous serpent, which she found near her infant, and which she quickly despatched, filling the air all the while with the most piercing shrieks. Dr Clarke does not describe to what species this serpent belonged. The gecko is a deadly reptile of the lizard tribe, resembling a chameleon, his head triangular and large, the eyes large, the tongue flat, rounded at the end, and covered with small scales, and the teeth so sharp as to make an impression on steel. It is of a green colour, spotted with brilliant red, and its bite kills in a few hours. The viper is remarkable for the malignity of its poison. It is about the thickness of a man's arm, about two feet long, and beautifully variegated with yellow and brown spots. The black serpent is about a cubit in length, and the thickness of a man's finger. Its bite is not incurable. The cerastes, or horned viper, described by Bruce, is also found in Palestine; and the asp, the well-known cobra di capello. The former moves with great rapidity backwards or forwards, and has all the cunning of the serpent brood, creeping silently, and with its head averted, towards the object of its attack, until within a sufficient distance for the fatal spring. This is supposed to be the adder of the Scriptures. Other species of serpents are enumerated; and to this frightful catalogue is added the scorpion, whose bite, though not deadly, causes serious illness and pain. The country is occasionally visited by swarms of locusts, in such numbers that they darken the air, and consume grass, foliage, and every description of vegetation.

Population. Palestine has been so often conquered and occupied by foreigners, that its population now presents a mixture of different races, so that it is not easy to say to what class the inhabitants chiefly belong. The Turks, the last conquerors of the country, are numerous, and occupy all the civil and military posts; but the Greek Christians are also a numerous body, and form a great proportion of the inhabitants of the towns. There are, besides, the Druses and the Maronites; the European Christians, Jews, Armenians, and Nestorians; and the wandering Arabs, who range over the desert plains. The Greek Christians enjoy the most ample toleration; and there is scarcely any considerable city without one or more convents. The Christians are generally more active in trade than the Mahommedans, and they have gradually increased in numbers and in wealth. In some places they mingle more freely with the Moslems than in the more civilized parts of Syria, to which the power of the pashas extends; and enjoy a community of privileges, without any enforcement of those odious distinctions of dress, tribute, and name, imposed by the Turkish oppressor, as the badge of servitude. It was asserted to Mr Buckingham, that there are Bedouin Arabs dwelling in tents, who have been converted to the Christian faith, and live in the regular exercise of that religion. But of those remarkable converts he could obtain no account. These Christians, however, profane their creed by an admixture of superstitious rites; and Dr Clarke, as well as other travellers, gave them no credit for the morality of

[1] Maundrell's Journey, p. 9.

[2] Buckingham's Travels in Palestine, vol. i. p. 189.

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their lives. The contentions of the different Christian sects in Jerusalem, for admission into the temple, are often stained with blood; and many other examples are given of their gross superstition, and ignorance of the first principles of the Christian faith. After observing, that in Jerusalem there are sects of every denomination, and perhaps of almost every religion upon earth, Dr Clarke observes, "if we add, that, under the name of Christianity, every degrading superstition and profane rite equally remote from the enlightened tenets of the gospel and the dignity of human nature are professed and tolerated, we shall afford a true picture of the state of society in this country."[1] The Druses, who reside in the mountains of Libanus, are a singular sect, whose tenets appear to incline to deism, as they profess to regard all modes of faith with equal indifference. Their number is estimated at 120,000. They are valiant, and faithful to their emirs or chiefs, and rigidly adhere to the barbarous principle of revenging blood by blood. Of the doctrines, practices, and manners of this singular sect, no very accurate account has ever been obtained. Dr Clarke, who conversed with one of them respecting their peculiar tenets, says that they worship Jonas the prophet, and Mahommed. Their rites are pagan, and they pay the highest adoration to a calf. Those with whom he conversed confessed that the pantheon of the Druses admitted indiscriminately, as objects of adoration, every deity or idol that had been worshipped by Heathens, Jews, Christians, or Mahommedans; all the prophets, especially Isaiah and Jeremiah, as well as Jesus and Mahommed; that every evening the okhals or priests set up a molten idol in the form of a calf, before which persons of both sexes make their prostrations; and then he adds, that a promiscuous intercourse takes place between the sexes. It seems doubtful, however, whether this stain of licentiousness can attach to the whole sect, as it is inconsistent with those habits of strict probity and industry, and that love of independence, which they are admitted on all hands to possess. The same traveller afterwards adds, that it is not true that they betray any inclination to Mahommedanism, because they show every mark of hatred and contempt to the Moslems, while they behave with benevolence and kindness to the Christians, whose religion they respect. Their language is Arabic; in every thing else they are a distinct race of men. From their physiognomy alone Dr Clarke was able to select one of the Druses from a whole company of Arabs. "A certain nobleness and dignity of feature," he adds, "a marked elevation of countenance, a superior deportment, always distinguished them, accompanied by openness, sincerity, and very engaging manners."[2] Although Mount Libanus be the chief residence of this sect, individuals are scattered over every part of the Holy Land. The Maronites, to the north of the country of the Druses, are inhabitants of the mountains of Syria, though great numbers of them dwell in Palestine. The inhabitants of Sephaury are chiefly Maronites, and they are found in Nazareth, along with Greeks and Catholics, as well as in other cities of Galilee. They are connected with the church of Rome, though they maintain the legality of marriage among the priesthood. Their patriarch resides at Karobin, in Syria, which may be considered as their capital. They are industrious cultivators; the common people, and also the sheiks, living economically, says Malte-Brun, under a rustic roof, and receiving with hospitality and kindness every Christian traveller into the bosom of their families. The Jews are found in considerable numbers throughout Palestine. Of late years they have greatly increased, though they are a degraded race, not only tyrannized and trampled on by the Turks, but exposed to every species of cruel indignity. Mr Buckingham mentions, that while he was travelling from Nazareth to Tiberias, he met a party of Jews mounted on asses, who, considering him, from his Turkish dress and white turban, to be a Mahommedan, all dismounted and passed by on foot. "These persecuted people," he adds, "are held in such opprobrium here, that it is forbidden to them to pass a Mussulman mounted, while Christians are suffered to do so either on mules or asses, though to them it is also forbidden to ride on horseback without the express permission of the pasha." The Bedouin Arabs wander in considerable numbers over the desert plains of Palestine. In habits, dress, and manners they very nearly resemble their brethren of the Arabian deserts. They subsist by pasture and robbery, attacking and murdering, without remorse, the defenceless traveller who may fall in their way. The open country is, in this manner, a scene of rapine and violence. The husbandman who sows is never sure of reaping the harvest; his cattle, his corn, may be swept away in a moment by an irruption of Arab cavalry from the eastern deserts. The robbery of the way-faring man when he fell among thieves in his journey among the mountains of Jericho, and the surprise, by three bands of plunderers, of Job's sons when their camels were carried off and themselves put to the sword, are events often realised in the modern history of Palestine. A certain ill-regulated police prevails in the towns, under the rule of the Turkish pashas, though without any sure protection either for life or property; and their power is as frequently used in plundering as in protecting their subjects. But throughout the deserts there is no form of civil order or authority to control the lawless violence of the Arab hordes, and life and property are only held by the tenure of the sword. All ranks, accordingly, whether cultivators or traders, carry arms; partly, says Mr Buckingham, that their country is sometimes scoured by horse Arabs from the eastern deserts, when they must stand on their defence, "and partly because it is the fashion to be armed, insomuch that the being without weapons of some kind or other is always imputed to great poverty or to cowardice." Manners are formed by circumstances, and this habit of wearing arms strongly marks a disorderly state of society. The unhappy peasantry may be regularly plundered by the pashas, or by a sudden inroad of Arab horsemen. The fields are in this manner neglected; the country in many parts lies desolate; the fertile soil, to use the expression of an eloquent writer, maintaining an unequal conflict between the bounty of Providence to renovate, and the wickedness of man to destroy. In the more barbarous parts, where the cultivators live in a state of complete independence of pashas or other governors, there is no private property in land. It is so abundant that the only claim to any particular spot is having ploughed it, which entitles the person to the produce of the harvest for that season. The dress of those Arabs in Palestine, and throughout all Syria, especially of the men, is simple and uniform, consisting of a blue shirt of cotton cloth descending below the knees, the legs and feet being exposed, or covered with ancient buskin, or with the sandal exactly as it is seen on some Grecian statues. They sometimes wear a cloak of very coarse and heavy camel's hair-cloth, with broad black stripes passing vertically down the back. It is one square piece, either with or without a seam down the back, as was the garment of our Saviour, for which the soldiers cast lots,—"it was without seam woven from the top;" and on this account it is always esteemed the more valuable. A small turban, or rather a dirty rag, is bound across their temples, one corner of which, sometimes fringed with strings in knots, is allowed to hang down. The Arab women seem as if they took pains to disfigure themselves. According to Dr Clarke, they render their persons

[1] Travels in Palestine, vol. ii. chap. xiii. p. 405.

[2] Ibid. vol. ii. chap. xiv. p. 460.

as hideous and disgusting as any barbarians of the South Seas. Their faces, heads, and arms are tattooed and covered with hideous scars; their eye-lashes and eyes are always painted with some dingy black or blue powder; their lips of a deep and dusky blue; their teeth jet black; their nails and fingers brick red; and their wrists as well as their ankles laden with large metal cinctures studded with sharp knobs and bits of glass. Their countenances are further disfigured with other unsightly ornaments. A small button studded with pearl, or a piece of glass or any other glittering substance, is fastened by a plug and thrust through the cartilage of the nose. Sometimes they have a large ring depending from the nose, and covering the upper lip; in short, all the devices of vanity in this country have the effect of maiming and disfiguring rather than of adorning the persons of the Arabian females. The same state of society and manners prevails among the Bedouin Arabs who inhabit Palestine as among those who traverse the Arabian deserts; and for farther particulars of their peculiar habits the reader is therefore referred to the article ARABIA, where their character and customs are fully described.

When the promised land was divided among the ten tribes, Judah, Benjamin, Simeon, Dan, Ephraim, Zabulon, Naphtali, and part of Manasseh, were placed on the western, commonly called this side of Jordan, while Reuben, Gad, and the remaining part of Manasseh, were placed on the eastern side, commonly called beyond Jordan.

The following table contains the ancient Canaanitish division of Palestine, and its division among the twelve tribes, compared with its division by the Romans.

Ancient Canaanitish Division.	Israelitish Division.	Roman Division.
Sidonians	Tribe of Asher (In Libanus.)	Upper Galilee.
Unknown	Naphtali (North-west of the Lake of Gennesareth.)	
Pheresites	Zebulon (West of that lake.)	Lower Galilee.
The same	Issachar (Valley of Esdraelon. Mount Tabor.)	
Hivites	Half tribe of Manasseh (Dora and Cæsarea), mingled with the following.	Samaria.
The same	Ephraim (Sichem, Samaria, district of Sarouas.)	
Jebusites	Benjamin (Between Ephraim and Judah. Jericho. Jerusalem.)	Judea.
Hethites, Amorites	Judah (Hebron. Judea proper.)	
Philistines (Pentapolis, Palæstina propria.)	Simeon (South-west of Judah.)	
	Dan (Joppa, &c.)	
Moabites	Reuben (Peræa proper, southern Hesbon.)	Peræa.
Ammonites, Gilead	Gad (Northern Peræa, part of Decapolis and of Ammonitis.)	
Kingdom of Bashan	Half tribe of Manasseh (Gaulonitis, Batanea.)	

The Canaanites and Israelites having long led the lives of shepherds, their limits are not quite distinct. Michaelis could not complete the researches which Reland and D'Anville began, nor can any one. The tribes of Simeon and Dan do not appear to have ever occupied their whole territory. The Philistines lived in them in a state of vassalage. The tribe of Asher was expelled from the sea-coast by the Tyrians: Reuben, Gad, and the eastern half of Manasseh, appear never to have subjugated all the Ammonites and Moabites.

History.

When the children of Israel took their departure from Egypt, Moses was their ruler and their guide. It was through him that their Divine Legislator gave them laws and statutes, the administration of which was also committed to him; and he led them through the wilderness, where they were fed by the miraculous interposition of heaven. But the burden of his office being too great for him, the judicial duties were divided; all lesser causes being, by the advice of his father-in-law, referred to the rulers of thousands, of hundreds, of fifties, and of tens,[1] while those of greater moment were only submitted to the chief judge; the power of making laws in this holy community being the high prerogative of its Divine head, and obedience being all that was required of man. The duties of a Jewish ruler were simplified and greatly abridged, being confined to the guidance of the host through the wilderness or in battle, though even here every important movement was directed by means of the pillar of the cloud by day or of the fire by night.

Moses was succeeded in his office by Joshua and the other judges; and when the host of the Israelites had obtained possession of the land of Canaan, which was to be equally divided as an inheritance among the ten tribes, and where they were to rest from all their toils, new laws were given them by the same authority, adapted to the situation in which they were now placed. The land was partitioned by lot among the different tribes, and was again subdivided among the families of the same tribe, and was declared inalienable, and the perpetual inheritance of the families to whom it was originally assigned. Accordingly, every fiftieth year, which was proclaimed to be a year of jubilee, all debts and mortgages on land were declared to be cancelled, and every man was to return into his own land, which was not to be sold for ever, but on which all burdens that had been incurred were to cease. Other laws were passed for enforcing the purity of divine worship and of moral conduct, and of equity in the transactions between man and man; also for the punishment of idolatry and other iniquities, for it was the peculiar distinction of this community, that the law took cognisance not only of offences against society, but of every breach of the divine commands. The order of the priesthood was also instituted in the family of Levi; gifts and sacrifices were offered by them in expiation of sin; and various acts were enumerated by which the children of Israel became unclean, and which, though innocent in themselves, were yet employed to point out the great defilement of sin, and for which, therefore, certain modes of purification were appointed. The distinction was also laid down between clean and unclean animals, from the latter of which the holy people were commanded to abstain. An enumeration was made in the plains of Moab, of all the males of the children of Israel above twenty years of age, and the sum of them is given at 601,700; the Levites, who were not mentioned among the rest, amounted to 23,000, which makes the sum of 624,700 males above twenty years of age. Every male being liable to military service, Israel could thus bring into the field a powerful military force, by whose irresistible attack, aided by the favouring interposition of heaven, all the minor states of Canaan were overwhelmed. After the death of Moses the supreme rule in Israel was vested in judges, under whom was an inferior officer, namely, the prince of the tribe, or the head of thousands; and under him the princes of families, or commanders of hundreds; though the powers possessed

[1] Exod. chap. xviii.

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by the chief judge have never been exactly defined, nor in what relation he stood to the other subordinate rulers in Israel. The Israelites, after their settlement in the land of Canaan, were involved in wars with the surrounding states, and were often given into their hands on account of their disobedience. The land was in this manner frequently wasted, and the earthly happiness of the chosen people interrupted, by the inroads of their neighbours. From these enemies they were saved by deliverers raised up to them, under whose peaceful sway the land enjoyed long intervals of rest. But during the old age of Samuel, in consequence of the perversion of judgment through bribery by unfaithful judges, the people were dissatisfied, and entreated, against the solemn protest of this aged prophet, that they should have a king, like the nations around them; and Samuel was desired to hearken to their request. Saul was accordingly chosen king, from whom, on account of his disobedience, the kingdom was rent, and given to David; and he terminated his fatal course in a disastrous defeat on the mountains of Gilboa, in which he and his son Jonathan were slain. David now ascended the throne without dispute, and commenced a prosperous reign, in the course of which he subdued all his enemies; and although the peace of the country was disturbed by the domestic treason of Absalom, yet he left a flourishing kingdom to his successor Solomon, under whose reign Judea was enlarged on every side, and became one of the most flourishing empires of Asia, extending on the east as far as the Euphrates, and, possessing ports both on the Mediterranean and on the Red Sea, had begun to rival Tyre in arts as well as in commerce. David was a man of war, but Solomon was devoted to peace; and during his reign, accordingly, was constructed that magnificent temple at Jerusalem, which was the wonder of future ages. From the ports of the Mediterranean, also, the trade of Judea was extended to the most distant parts. "Every three years," it is said, "once came the ships of Tarshish, bringing gold and silver, ivory, apes, and peacocks."[1] These are the productions of India, which Solomon had received from these ships, in exchange, it is said, for the fine wheat of Syria, which was largely exported. These ships of Tarshish, it is supposed, descending the Persian Gulf, stretched across the Indian Ocean to the coast of Malabar, whence they again returned with the favourable monsoon; a hazardous voyage in that early age, which, with the time put off in trading at the intermediate ports, might well occupy three years.

After the death of Solomon, the kingdom of Judah was divided into two sovereignties. The tyrannical conduct of Rehoboam, in which he persisted, against the advice of his aged councillors, gave rise to the revolt of the ten tribes, who chose Jeroboam for their king; and thus began that division of the empire which paved the way for its downfall, under the successive attacks of its enemies. The kingdoms of Israel and Judah were hereafter ruled by different monarchs, who, no longer joining against their common enemies, waged war against each other; and who, in place of the union that might have been expected in the descendants from a common stock, regarded each other with all the aversion of aliens. In the mean time, the powerful empires of Assyria and Babylon in the east, and of Egypt in the south, were now contending with each other for the dominion of the world. Their vast armies had frequently threatened the comparatively petty state of Judea; and at length, in the reign of Hoshea, 719 years before the Christian era, Samaria, the capital of the kingdom of Israel, was taken by the king of Assyria, the land was conquered, and the whole nation carried into captivity.

We subjoin a list of the kings who reigned in Samaria, with the length of their several reigns, and the period when they reigned.

	Years.	B. C.		Years.	B. C.
1. Jeroboam	22	990	12. Jeroboam II.	41	834
2. Nadad	2	968	1st Interregnum	22	793
3. Baasha	23	966	13. Zechariah and Shallum	1	771
4. Ela	1	943	14. Menahem	10	770
5. Zimri and Omri	11	942	15. Pekahahiah	2	760
6. Ahab	22	931	16. Pekah	20	758
7. Ahaziah	2	909	2d Interregnum	10	738
8. Jehoram or Joram	12	907	17. Hoshea	9	728
9. Jehu	28	895			
10. Jejoahaz	17	867	Samaria taken	271	719
11. Jehoash or Joash	16	850			

The kingdom of Judah, weakened by the loss of the ten tribes, was in its turn assailed by the king of Babylon. During the reign of Jehoiakim, Nebuchadnezzar invaded Palestine with a formidable army, which the Jews had no means of resisting; and the ruin of the nation was for a time only averted by prudent submission. But the humbled king, impatient of dependence, seizing, as he thought, a favourable opportunity, made a new effort to throw off the yoke of the king of Babylon. The siege and capture of Jerusalem was the consequence of this rash attempt, when the king and all the princes of Judah were carried captives to Babylon. His son Jehoiachin was set up to reign in his stead, who was also brought to Babylon, with all the precious vessels belonging to the temple, and Zedekiah was declared king. He, like his predecessors, took up arms against the king of Babylon, who, incensed by these repeated rebellions, resolved on the destruction of Jerusalem, and the utter extermination of the Jewish nation. Jerusalem was accordingly besieged by a powerful army; the Jews made an obstinate defence, and the siege lasted for about fifteen or sixteen months, in the course of which famine and disease raged within the walls of the city, which was at last taken and sacked, and all the chief inhabitants carried captives to Babylon, the poor of the land being only left to be vine-dressers and husbandmen. The king was severely punished for his rebellion; his sons were put to death before his eyes; he himself was deprived of his eye-sight, and being loaded with fetters, was carried prisoner to Babylon.

The following is the line of kings who reigned in Jerusalem from the death of Solomon to the destruction of the first temple.

	Years.	B. C.		Years.	B. C.
1. Rehoboam	17	990	11. Jotham	16	757
2. Abijah	3	973	12. Ahaz	16	741
3. Asa	41	970	13. Hezekiah	29	725
4. Jehoshaphat	25	929	14. Manasseh	55	696
5. Jehoram or Joram	8	904	15. Amor	2	641
6. Ahaziah	1	896	16. Josiah	31	639
7. Queen Athaliah	6	895	17. Jehoahaz	3 mths.	
8. Joash or Jehoash	40	889	18. Jehoiakim	11	608
9. Amaziah	29	849	19. Coniah or Jehoiachin	3 mths.	
Interregnum	11	820	20. *Zedekiah*	11	597
10. Uzziah or Azariah	52	809	Jerusalem taken	404	586

Seventy years were appointed as the term of the Jewish captivity, in the course of which the empire of Babylon was overthrown by Cyrus the king of Persia, under whose auspicious and friendly reign the Jews, consisting now only of the tribes of Judah and Benjamin, were encouraged

[1] 2 Chron. chap. ix.

to rebuild their city, and to return to their own land. Zerubbabel, Nehemiah, and Ezra, were the leaders that presided over the restoration of the Jewish kingdom. After many interruptions from the jealousy and power of their enemies, the second temple was at length reared. But it was so inferior in splendour to the temple reared by Solomon, that the aged men wept when they contrasted this modern structure with the glory of the first house. There was wanting, besides, the ark, the holy oracle, with the emblematical light of the Divine presence, the Urim and the Thummim, from which the divine response was given to the inquiries of the high priest. The Jews were now ruled by the Persian king and his lieutenants, in civil though not in sacred things, which were regulated by the law of Moses, as administered by their own high priests; and they enjoyed for a period nearly of two centuries the blessings of a settled government. After the conquest of Persia by Alexander, and the division of his kingdom among his successors, Asia was distracted by new wars among those rivals for the supreme dominion, and the Jews, often embarrassed by these contentions, owed their independence rather to the forbearance of their enemies than to their own strength. At length, however, Antiochus Epiphanes, having heard of insurrections among them, invaded their territory with a powerful army, and besieged and took Jerusalem while it was yet unprepared for defence. He wreaked his vengeance on the unhappy Jews, 40,000 of whom were put to death, and an equal number reduced to slavery. Other unheard-of cruelties were perpetrated by his licentious soldiery, and the holy sanctuary itself was grossly profaned. The temple was plundered of all its sacred utensils, the golden candlestick, the table of shew-bread, and the altar of incense, and an unclean animal, a sow, was offered by his orders on the altar of burnt offerings; part of the flesh was boiled, and the liquor sprinkled around, where only the purifying blood of the holy sacrifice had been seen before. The Jewish nation was at the same time cruelly persecuted; an edict was issued for the extermination of the whole race; and, in furtherance of this barbarous policy, Apollonius, the commander of the troops, when the people had assembled in Jerusalem on the holy Sabbath, made a furious attack with his troops on the peaceful multitude, whom he slaughtered without mercy, or carried into a hopeless captivity. The city was plundered, and set on fire in many places; the walls were broken down, and a strong fortress built on Mount Zion, which commanded the temple and the adjacent parts. Having made these preparations, he proceeded to farther persecutions against the religion of the Jews. They were watched in their visits to the holy sanctuary, and harassed by the troops; the rite of circumcision was prohibited; and a compliance with the heathen idolatries was enforced at the point of the sword. They were compelled to profane the Sabbath, and to eat swine's flesh. The holy temple was violated by the worship of Jupiter, whose statue was erected on the altar of burnt-offerings, and the licentious revels of the Bacchanalia were substituted for the pure festivals of the Jewish church. The barbarities that were inflicted as the penalty of disobedience to these impious commands exceed all belief, and are too shocking to be detailed. The rage of persecution spared neither age nor sex; and all over the country torture and death were inflicted on the unhappy persons who, remaining stedfast in their faith, refused to participate in these heathenish rites.

But the tyrant who was thus aiming at the extermination of the Jews was scattering over the land the seeds of independence, and insuring his own overthrow. The unheard-of cruelties committed by his command excited the deepest indignation, and at length roused the nation to resistance. The heroic family of the Maccabees, consisting of five brethren, the sons of Matthias, a priest of the race of Asmones, were the champions of the patriotic cause. They were all of incomparable valour; and Judas having headed the insurgents, a determined band, though small in number, defeated the oppressors of his country in many great battles, and restored its independence. But he had to contend against domestic treason as well as foreign war. Alcinus, who was in the interest of the Syrians, assuming the title of high priest, claimed the allegiance of the Jews, and Judas was compelled in self-defence to seek the alliance of the Romans, who willingly sought a pretence for interference in the affairs of their neighbours. In the mean time the Maccabee chief was slain in the field of battle, and was succeeded by his brother Jonathan, who, employing his power in aiding Alexander in his competition for the throne of Syria, was allowed by him in return to unite the spiritual authority of the high priest with the temporal sway; and under this dynasty of the Asmonean princes Palestine was governed for more than a hundred years. Jonathan was succeeded by his son Simon, who secured the tranquillity of the country by cultivating the friendship of Rome. He was cut off, the victim of domestic treason, and John Hyrcanus, his younger son, ascended the throne. His reign was prosperous and successful. He not only threw off the Syrian yoke, but extended his territories eastward and northward. He besieged and utterly destroyed Samaria; and thus gratified the vindictive spirit of the Jews against the Samaritans. The short reign of Aristobulus, his son, followed; afterwards that of Alexander Jannæus, whose oppressions excited a civil war in the country. The insurgents, calling in the aid of the Syrians, became unpopular; and Alexander, after many reverses, at last succeeded in collecting a powerful army, with which he entered his capital in triumph, and took severe vengeance on his enemies, ordering a thousand men to be executed on the cross, and their wives and children to be butchered before their eyes. He was succeeded by his son, Hyrcanus the second. His brother Aristobulus, after secretly opposing him for some time, at length threw off the mask, and openly aspired to the supreme power. The two competitors were preparing to appeal to arms, when the Romans under Pompey, having subdued the greater part of Syria, were now called into Palestine as peaceable arbiters in this dispute. Aristobulus being, however, impatient, had recourse to arms, and shut himself up in Jerusalem, which was invested by the Roman general Gabinius, the lieutenant of Pompey, and carried by assault with prodigious slaughter. The authority of Hyrcanus was re-established, and Aristobulus was carried prisoner to Rome, whence afterwards making his escape, he raised the standard of revolt in Judea. But he had no force that could oppose the Roman armies under Mark Antony, who speedily re-established the authority of Rome in every part of the country. The rule of Judea was now delegated to Antipater, the minister of Hyrcanus, who appointed his two sons, Phasael and Herod, to be governors, the one of Jerusalem, the other of Galilee. But a new competitor appeared for the supreme authority in Judea, namely, a son of Aristobulus, who, having taken refuge among the Parthians, invaded the country with a powerful army; he laid siege to Jerusalem, which he took and pillaged; he put to death the eldest son of Antipater, Phasael, and rendered Hyrcanus incapable of the priesthood, by the extraordinary contrivance of biting off his ears. The Romans, however, now ruled in Judea; they were the supreme arbiters of its fate, and they placed on the throne Herod, the younger son of Antipater. He was of a cruel and jealous disposition, and in his fury he put to death his beloved wife, the beautiful Mariamne, the grand-daughter of Hyrcanus, her mother, brother, grandfather, uncle, and two sons; nor was he popular among

Palestine.

the Jews, owing to his attachment to and his open participation in the idolatrous rites of the Romans. He reigned thirty-four years. "A man," says Sandys, "full of admirable virtues and execrable vices; his acts had deservedly given him the addition of great; fortunate abroad, unfortunate in his family, his life tragical, his death desperate."[1] He died from the effects of a loathsome disease. He employed himself in works of architecture, particularly in the repair of the temple, by which he hoped to obtain favour among the Jews. It was in his reign that the Messiah was born, and it was from his cruelty that he fled into Egypt. He bequeathed his dominions to his two sons; to Archelaus the government of Idumea, Samaria, and Judea; and to Antipas that of Peræa and Galilee. Archelaus was soon after deprived of his great office, on account of mal-administration, and banished into Gaul. Judea was now reduced to the condition of a Roman province, under its own ruler or governor, who resided at Jerusalem, but who was subordinate to the prefect of Syria, which dignity was conferred on Publius Sulpicius Quirinus, who is mentioned in Luke's gospel under the name of Cyrenius. The government of Judea was conferred on Pontius Pilate, under whose authority the Saviour was crucified. The Jews were far from being a contented or happy people under the Roman yoke. They were exposed to the severe exactions of their delegated rulers, and to outrages and plunder by the Roman soldiers stationed in the province to overawe the people. Rebellion, provoked by these oppressions, and quelled by the legionary troops, became the pretext for fresh cruelties; and misery, disorder, and violence, thus reigned throughout the once happy land. The only portion of the country that enjoyed comparative quiet was Galilee and the country beyond Jordan, which was ruled by Antipas and Philip. It was the latter, Philip Herod, who married Herodias, his brother's wife, and who was afterwards banished to Gaul by Caligula. His nephew Agrippa was advanced to the government of all Palestine, with the title of king. His policy was conciliatory towards the Jews; he respected their worship, repaired and adorned the temple; while he joined with them in their persecution of the new sect of Christians, having cast Peter and James into prison. His melancholy end, being eaten of worms, is related in the Acts of the Apostles. His son Agrippa succeeded him, before whom, as is mentioned in the Acts of the Apostles, Paul pleaded his cause. The successors of Pontius Pilate in the government of Judea were Felix, Petronius, Festus, Albinus, and Florus. The provincial government of Rome was a pure despotism, without even those imperfect safeguards from oppression which existed at home. The great men of Rome were enriched by the spoils of the conquered provinces; the distance from the capital exempted them from control; nor was there any legitimate channel through which the aggrieved could seek redress. The discontent of the Jews, their impatience of the Roman yoke, their proneness to insurrection under the vain predictions of their soothsayers, that a conquering Messiah was to arise, who would restore the independence and glory of their country, afforded too fair a pretence for the severities of their rulers; and accordingly, though there were some, such as Festus, who followed the maxims of equity, yet the Roman yoke was heavy and oppressive, and the administration of Felix, Florus, and others, was corrupt and tyrannical in the extreme; the people were borne down by heavy exactions, they were irritated and trampled upon by a licentious soldiery; and when they were driven to rebellion by these atrocities, they were overwhelmed by the disciplined legions of Rome, and slaughtered without mercy. The country abounded, accordingly, in scenes of rapine and anarchy; the national faith and the holiest rites were despised and trampled upon; and at length, under the administration of Florus, the people flew to arms, and entered on their last and desperate conflict with the Roman power. The insurrection broke out in Cæsarea, the inhabitants of which, galled by cruel insults, declared their determination to resist to the last extremity. The Jews in the capital shared in this heroic determination, and made preparations for defence. Cestus, the prefect of Syria, advanced to the gates, and demanded an entrance for the Roman troops. The Jews refused to comply with this summons, and expecting an assault, they beheld the Roman army, to their surprise, in full retreat. They were pursued by the incensed multitude, and being overtaken in a difficult pass of the mountains, they were attacked by the infuriated Jews, and, after a great slaughter, were forced ignominiously to take flight.

The intelligence of these disasters excited the indignation of Nero, who was then in Greece, against the rebellious Jews; and Vespasian, of tried valour and experience, was immediately sent to assume the government of Syria, and to calm the troubles of this distracted province. He entered Judea about the year 67, along with his son the renowned Titus, to whom was committed the conduct of the war. Many sanguinary battles were now fought between the contending armies, in which the tumultuary levies of the rebellious Jews were broken and dispersed by the veteran legions of Rome; towns and fortresses were successively taken; and the Jews, no longer able to face the enemy in the field, were driven within the walls of their capital, to which Titus with his victorious army lost no time in laying close siege. The defence was obstinate; the besiegers were brave and numerous, and employed all the resources of the military art in the attack on the devoted city. In the course of this protracted siege partial successes were obtained by the Jews, who fought bravely, and harassed the besiegers by frequent and successful sallies. But the defences of the city, strong both by nature and art, gradually gave way before the perseverance and skill of the Roman troops; and as Titus proceeded partly by blockade, he shut in the whole city with a wall, and the horrors of famine were added to all the other miseries which the inhabitants suffered. The walls, where they were shattered by the battering rams, or undermined by other arts, were thrown down; the most valiant of the soldiers rushed through the breach, and were engaged in a close and bloody conflict with the besieged, for the possession of the temple. "Both sides," says Josephus, "drew their swords and fought it out hand to hand. Now, during this struggle, the positions of the men were undistinguished on both sides, and they fought at random, the men being intermixed one with another, and confused by reason of the narrowness of the place, while the noise that was made fell on the ear in an indistinct manner, because it was so very loud. Great slaughter was made on both sides." But still there was no room for flight or for pursuit, the troops in dense masses being mingled together in the deadly struggle. It would be endless to detail all the horrors of this protracted siege; famine raged within the walls; every inch of ground was fiercely disputed; and prodigious numbers of men fell on both sides. But the Romans made a steady progress. Their ensigns were advanced on the battlements of the temple, which was set on fire; the battering rams were then directed against the walls of the upper city, and a breach being effected, the place was carried by storm; the inhabitants were everywhere put to the sword or made captives, and sold for slaves. The number of Jews who perished in the siege is estimated at 1,100,000; a far greater population than the city ever contained. But

[1] Sandys' History of the Holy Land, p. 144.

the annual feast of unleavened bread, which took place at this time, had crowded the city with a vast concourse of strangers from all quarters, who, by the sudden approach of the hostile army, were shut up within the walls. When the Roman soldiers had ceased from their work of slaughter and desolation, because, says Josephus, there were no more people to slay or plunder, the city was consumed with fire; and the wall, except that which enclosed the city on the western side, and three towers which were left as quarters for the Roman garrison, was laid even with the ground by those who "dug it to the foundation; that there was nothing left to make those that came thither believe that it had ever been inhabited."

The Romans having thus reduced the country, divided that portion of it that was on this side of Jordan into the three tetrarchies of Judea proper, Samaria, and Galilee, the first comprehending the tribes of Judah, Benjamin, Dan, and Simeon, the second the tribes of Ephraim, Issachar, and part of Manasseh, and the latter the tribes of Zabulon, Asher, and Naphtali. The region to the east of Jordan was divided into the smaller districts of Peræa, Decapolis, Gaulonitis, Galauditis, Batanea, and Auranitis.

After the Roman armies were withdrawn from Jerusalem, many of the Jewish tribes returned to dwell in the ruined city, though the Roman emperor, indignant at the late rebellion, had placed a garrison of 800 troops on Mount Zion, in order to prevent any attempt to rebuild the sacred capital, the capture and sack of which was a fatal blow to the prosperity of the Jews, and was the commencement of a long era of calamity, which ended in the utter dispersion of the nation. A portion of the country was yet, indeed, unscathed by the flames of war; the towns on the coast submitting to the conqueror escaped the horrors of a siege and the penalties of rebellion, while the provinces beyond Jordan enjoyed tranquillity under the rule of the conquerors. But the Jews were discontented and rebellious under the tyranny of Rome; they still fondly believed that an earthly Messiah was shortly to arise, to free them from bondage, and to give them the dominion of the whole earth. They accordingly listened to the tales of every impostor, and were easily seduced into rebellion by vain hopes of national glory, that were never realised. Hence their continual insurrections, which exposed them still farther to the vengeance of the conqueror, and accelerated the crisis of their fate, when they were to be driven from their own land, and dispersed over the face of the earth.

"From the reign of Nero," says the historian of the decline and fall of Rome, "to that of Antoninus Pius, the Jews discovered a fierce impatience of the dominion of Rome, which broke out into the most furious massacres and insurrections." He then gives a recital of their cruelties, and enters into an enumeration of shocking atrocities, which he accuses them of having committed, on the suspicious authority of the heathen writers, who hated the Jews, and, from Tacitus downwards, give a distorted view of their institutions and national character. The fact however is certain, that, throughout the cities of Egypt, Cyprus, and Cyrene, the Jews stirred up fierce insurrections, and flew to arms in order to avenge themselves on their insulting foes. In the course of this internal war great cruelties were committed. But in the end the Jews were everywhere borne down by the discipline of the Roman legions, and paid the penalty of their rebellion with their lives. Their towns were sacked and destroyed, and it is estimated that half a million of them perished in the field. In the island of Cyprus, where they were encountered by the military skill of the Emperor Hadrian, they were vanquished with prodigious slaughter, and expelled for ever from the island. By acts of mutual cruelty, the animosity of both parties was inflamed; the sword of persecution was let loose against the Jewish religion by their conquerors; the rite of circumcision, the reading of the law and the observance of the Jewish Sabbath, and all the other memorials of the national faith, were forbidden. In the city of Jerusalem, which was to a certain extent repaired, a colony of Greeks and Latins was established, in order to preclude the return of the Jews, and all further hopes of the restoration of their kingdom. But the policy of the Romans was of no avail against the deep-rooted prejudices of this infatuated people; and no sooner had a new impostor arisen, of the name of Barcochab, "the son of a star," than the deluded Israelites hailed him as the light that was to dawn in the latter days, and usher in the day of their long-expected rest. They accordingly crowded to his standard; and in a short time he had mustered a powerful army of 200,000 devoted followers. Owing to the absence of the Roman legions, engaged at that time in distant service, important advantages were gained, and Jerusalem was again occupied by the insurgent Jews, besides about fifty castles, and numbers of open towns. But this career of success was speedily terminated by the arrival of Severus, afterwards emperor, with a large and well-appointed body of legionary troops; the Jews were overwhelmed by numbers, discipline, and military skill; their cities were taken and destroyed; and Bither, where the leader of the rebellion, Barcochab, had made his last stand, was stormed with great slaughter, and himself slain. Of the Jews it is estimated that 580,000 died on the field, and the remnant who escaped mostly perished by famine and disease, or amid the flames of their ruined cities. Under these ruthless devastations the country was at last converted into a desert; the inhabitants were either slain or driven into exile; and the divine denunciations were now literally fulfilled against this misguided people, that they should be scattered among all the nations of the earth.

The victors having thus satiated their vengeance, began in due time to relax their stern and intolerant policy. Under the mild rule of Antoninus Pius, the Jews were restored to their ancient privileges, to the freedom of worship, and to all their other national rites. They were now mingled with the nations, and were found dwelling in all parts of the Roman empire; and their general condition under the Roman emperors, as described by Gibbon, was not unfavourable. "The numerous remains," says this eloquent historian, "of that people, though they were excluded from the precincts of Jerusalem, were permitted to form and to maintain considerable establishments both in Italy and in the provinces, to acquire the freedom of Rome, to enjoy municipal honours, and to obtain at the same time an exemption from the burdensome and expensive offices of society. The moderation or contempt of the Romans gave a legal sanction to the form of ecclesiastical police which was instituted by the vanquished sect. The patriarch, who had fixed his residence at Tiberias, was empowered to appoint his subordinate ministers and apostles, to exercise a domestic jurisdiction, and to receive from his dispersed brethren an annual contribution. New synagogues were frequently erected in the principal cities of the empire; and the sabbaths, the fasts, and the festivals, which were either commanded by the Mosaic law, or enjoined by the traditions of the rabbis, were celebrated in the most solemn and public manner. Such gentle treatment insensibly assuaged the stern temper of the Jews. Awakened from their dream of prophecy and conquest, they assumed the behaviour of peaceable and industrious subjects. Their irreconciled hatred of mankind, instead of flowing out in acts of blood and violence, evaporated in less dangerous gratifications. They embraced every opportunity of overreaching the idolaters in trade; and they pronounced secret and ambiguous imprecations against the haughty kingdom of Edom."[1] This statement, though it has received a colouring from the deep-rooted prejudices of the author against the Jewish religion, is nevertheless substantially true, and contains a just view of the condition of the Jews throughout the Roman empire. No great change appears to have taken place in the condition of Palestine, until Constantine ascended the imperial throne. He was, as is well known, the first Christian emperor; and under his powerful patronage, and that of his mother the Empress Helena, splendid structures were everywhere erected in the Holy Land, in honour of the Christian faith. The bishop of Jerusalem was ordered to erect a splendid temple on the tomb of the Saviour; and the Empress Helena repaired to Palestine, in all the ardour of new-born zeal, to explore the country for the relics of the sacred sepulchre, which was buried under an edifice, said to be the temple of Venus, raised by the Emperor Hadrian. Besides the temple which covered the holy sepulchre, she gave orders for the erection of other edifices, one at Bethlehem over the manger of the Messiah, and another over the Mount of Olives, to commemorate the ascension. The land was gradually overspread with these memorials of Christianity; and chapels, altars, and houses of prayer, marked every spot which was memorable for any of the sayings or doings of the Saviour. The Jews beheld with indignation the rise of these Christian monuments within the precincts of the holy city. They were as much opposed to the Christian worship as to the heathen idolatry, but their influence was now at an end. Scattered in distant parts, they could no longer act with consistency or vigour; yet, so attached were they to their own ancient rites, that, however faint the chance of success, they were ready in crowds to rally round the standard of their ancient faith, wherever it was displayed, and to follow any daring leader into the field. But the time was past. They were rejected by the divine decree, and were no longer to be assembled as a nation in their own land. Jerusalem was now filled with the emblems of a new faith, and crowds of pilgrims were attracted from the most distant countries, by the eager desire of contemplating the place of the Redeemer's passion, and of all the previous incidents of his holy life. These visits were encouraged from various motives. They evinced, no doubt, the zeal of the new converts; and being at once a proof of piety and a source of profit, they were encouraged by the clergy of Jerusalem. "The zeal," says the eloquent historian of the Roman empire, "perhaps the avarice, of the clergy at Jerusalem, cherished and multiplied these beneficial visits. They fixed by unquestionable tradition the scene of each memorable event. They exhibited the instruments which had been used in the passion of Christ; the nails and the lance that had pierced his hands, his feet, and his side; the crown of thorns that was planted on his head; the pillar at which he was scourged; and, above all, they showed the cross on which he suffered, and which was dug out of the earth in the reign of those princes who inserted the symbol of Christianity on the banners of the Roman legions."[2] To these deceptions was added a list of pretended miracles, by which the ignorant were duped and robbed of their money; and in the mean time, amid all this pretended sanctity, Jerusalem presented the grossest scenes of immorality and vice. The veneration evinced by strangers for the holy city never seems to have influenced the lives or practice of these votaries of indolence or pleasure, the relics in their possession being valued merely as a source of gain, and the means of worldly indulgence.

The reign of Julian was a new era in the history of Palestine, and the Jews anticipated, from his declared enmity to Christianity, his favour for their own purer faith. The policy of this heathen emperor countenanced them in this belief, when he endeavoured, by rebuilding the temple of Jerusalem in its former splendour, to discredit the truth of those prophecies which denounced perpetual desolation on the devoted city. He chose the commanding eminence of Mount Moriah for the site of a new structure, which was to eclipse the splendour of the Christian church on the adjacent hill of Calvary; and he resolved to establish a Jewish order of priests, who might revive the observance of the Mosaic rites, together with as numerous a colony of Jews as could be collected, in the holy city. Such was still the ardour of the national faith, that the Jews crowded from all parts, and exasperated by their insolent triumph the hostility of the Christian inhabitants. All now joined with unwearied zeal in the sacred work of rebuilding the temple. Liberal contributions poured in from all quarters; men and women joined in the pious labour; and the authority of the monarch was seconded by the enthusiasm of the people. But this last effort of expiring zeal was unsuccessful; no temple ever arose on the ruins of the heathen edifices; a Mahommedan mosque still stands on the ground of the Jewish temple; and the progress of the work, according to a fable generally believed at the time, was stopt by the terrific interposition of heaven, by flames of fire bursting out from the foundations of the temple with loud explosions, by which the workmen were so terrified that they refused on any consideration to continue their labour. This miracle is indeed attested by contemporary historians; but it is justly remarked by Gibbon, that the original evidence of impartial and intelligent spectators would still be necessary to establish its truth. Now this evidence is wanting; for though it is recorded by the Roman historians, among others by Ammianus Marcellinus, yet he reports it merely on hearsay; and it seems probable that, at the distance of twenty years, without any anxious inquiry, he might take the story on credit, that he might "adorn his history with the specious and splendid miracle."[3] The work, however, from whatever cause, was abandoned; and as it was only undertaken during the last six months of Julian's reign, the fact seems sufficiently explained without the aid of a miracle, by the absence and death of the emperor, and by the new maxims that were adopted during the Christian reign that succeeded.

After the death of Julian it was the policy of the Christian emperors to depress the Jews in Palestine, though they were not ill treated throughout the provinces, and were even granted considerable privileges and immunities. But it is astonishing how carefully the fathers instilled into the minds of their children, along with their ancient faith, the fondly cherished delusion, that some new and happier era of freedom and independence was yet to dawn on Judea; and how eagerly the children, imbibing this idea, became the prey of every impostor, and, under the blind impulse of enthusiasm, rashly entered into new conflicts with their enemies in the field, where they perished the willing victims of a hopeless cause. About the beginning of the seventh century the peace of Judea was seriously disturbed by the Persian invasion of Chosroes. The Greeks and the Persians were for a long period rivals for the dominion of the East; and Chosroes, the grandson of Nushirvan, now invading the Roman empire, successively stormed and sacked the cities of Antioch and Cæsarea. From Syria the flood of invasion rolled southward on Palestine, and the Persian army was joined by the Jews to the number of 24,000, still burning with the love of independence. The Christians and Jews were inflamed against each other by a long course of deep injuries given and received.

[1] Decline and Fall of the Roman Empire, vol. ii. chap. xvi. p. 386.
[2] Ibid. chap. xxiii. p. 101.
[3] Ibid. chap. xxiii. p. 109.

 Those of the former nation within the walls were massacred without mercy by their Christian enemies, while the Jews on the outside were burning with the desire of revenge. The advance of the Persians secured the triumph. The city was stormed by the combined armies, and the Jews were satiated with a full measure of revenge. The Christians neither sought nor found mercy; it was estimated that 90,000 of them perished in the storming of the city. Some were sold for slaves, and others were bought for the purpose of being murdered. The city was sacked, and the magnificent monuments of the Christian faith were mostly consumed by fire. The sepulchre of Christ, and the stately churches of Helena and Constantine, rifled, to use the words of Gibbon, in one sacrilegious day, of the devout offerings of three hundred years, were abandoned to the flames. But this, like all the other triumphs of the Jews, was short-lived. Heraclius was roused from inglorious sloth by the triumphs of the Persian arms, and by the approach of the victorious force to the walls of his own capital. He quickly assembled his veteran armies, by whose aid he defeated the troops of Chosroes; and in the course of a few successful campaigns he recovered all the provinces that had been overrun. He visited Jerusalem after his victories, in the lowly guise of a pilgrim, and prepared new triumphs for the Christians in the restoration of the magnificent churches which had been destroyed, and in the persecution of the Jews, and their banishment, as before, from the holy city, which they were now forbidden to approach within a nearer distance than three miles.

Palestine continued to own the sway of the Greek emperor till the rise of the Mahommedan power in the East. The followers of this impostor, extending their doctrines and their dominion by fire and sword, rapidly subdued Arabia, Syria, and Egypt, when, about the year 637, the victorious Omar turned his arms against Jerusalem, revered alike by Jews, Christians, and Mahommedans, as a holy city. After a siege of four months, during which the Arabs suffered extremely from the inclemency of the winter, a capitulation was proposed and agreed to, when the conqueror entered the city seated on a red camel, which carried a bag of corn and dates, and without guards, or any other precaution, and began to discourse in the most courteous manner with the patriarch, on its religious antiquities. Omar was assassinated in Jerusalem in the year 643, after which the East was for two hundred years distracted by the bloody wars that ensued among the Ommiades, the Abbassides, and the Fatimite caliphs; and Palestine having become an object of contest between them, was for a like period a scene of devastation and trouble. In the year 868, the capital was conquered by Achmet, a Turk; but was again recovered by the caliphs of Bagdad in the year 906. It was reduced by Mohammed Ikschid, of the Turkish race. Towards the end of the tenth century the holy city was taken possession of by Ortok; and in 1076 by Meleschah, a Turk. It was retaken by the Ortokides, and, finally, by the Fatimites, who held possession of it when the Crusaders made their first appearance in the Holy Land.

Jerusalem, though it was in possession of infidel chiefs, was still revered as a holy city both by Christian and Jew, and was visited by pilgrims from every quarter; among others by Peter the hermit, a native of Amiens. The pathetic tale which he brought to Europe, of the injuries and insults which the Christian pilgrims suffered from the infidels, who possessed and profaned the holy city, excited the deepest sympathy among the people and princes of Christendom. Councils were summoned, and were attended by bishops, a numerous train of ecclesiastics, and by thousands of the laity. At the council of Trent no fewer than four hundred mitred prelates were present. The mixed multitude were harangued by the zealous enthusiasts of this sacred cause; their pity and indignation were alternately roused by the sufferings of their brethren in the Holy Land; the flame of enthusiasm was propagated by sympathy and example; and the eager champions of the cross, the flower of the European chivalry, assembled in martial array, to march against the enemies of their common faith. To defray the necessary expenses of the expedition, princes alienated their provinces, the nobles their lands and castles, peasants their cattle and the instruments of husbandry; and vast armies were transported to Palestine, in order to accomplish the deliverance of the holy sepulchre. These rude and undisciplined bands died in great numbers on reaching the shores of Asia, from disease, famine, and fatigue; and, of the first Crusaders, it is estimated that 300,000 had perished before a single city was rescued from the infidels. Of the leaders in the Christian host, the first rank is due to Godfrey, duke of Brabant and Bouillon, who was accompanied by his two brothers, Eustace the elder, who had succeeded to the county of Boulogne, and Baldwin the younger. The other chiefs were, Robert of France, the brother of King Philip, and Robert Duke of Normandy, the son of William the Conqueror; Bohemond the son of Robert Guisard, distinguished by his cool policy and ambition, with a small addition of religious zeal; Tancred his cousin, who had imbibed the true spirit of chivalry, and all the virtues of a perfect knight; and Raymond of Thoulouse, the Duke of Narbonne, and Marquis of Provence, a veteran warrior of mature age and experience. The vast armies that were collected under the guidance of these leaders arrived by various routes at Constantinople, the Greek capital; after having lost, some say, half their number, in the intermediate march through unknown countries, by famine, disease, and the assaults of the inhabitants into whose countries they had made so unexpected an irruption. After some time spent in the capital of the East, they crossed to the opposite shore of Asia. Having taken the towns of Nice and Antioch in the year 1097, they laid siege to Jerusalem about two years after, which was taken by assault, with a prodigious slaughter of the garrison and inhabitants, that was continued for three days, without respect either to age or sex. Women, and children at the breast, boys and girls, were dragged forth and put to death without mercy; and the streets were covered with their dead bodies and mangled limbs. Having thus delivered the holy sepulchre, the Crusaders proceeded, while yet stained with blood, to perform their devotions at the sacred shrine; they ascended the hill of Calvary bare-headed and bare-footed, amid the loud anthems of the clergy, and they kissed the stone of the Saviour's tomb, and bedewed with tears of joy and penitence the monuments of their redemption.[1] To such a degree does blind fanaticism harden the heart and stifle the voice of pity. The grand and leading trait of Christianity is benevolence to man, without which there can be no piety to God. This principle is inculcated both by the precept and example of its divine founder, who took care on all occasions to reprove and put down the spirit of persecution, however cloaked under the specious pretext of religious zeal. Yet we find here his professed followers, under show of deep reverence for his name, shedding without remorse the blood of their fellow-creatures, of women and children, and approaching, with their profane adorations, to the holy sanctuary of the God of peace.

Eight days after the capture of Jerusalem, the Latin

[1] Decline and Fall, vol. xi. chap. lviii. p. 85.

Palestine. chiefs proceeded to the election of a king, who should preside over their conquests in Palestine, and Godfrey of Bouillon was unanimously raised to this high office. But if it was an honourable office, it was also one of danger; he was not chosen to sway a peaceful sceptre; and he was summoned to the field in the first fortnight of his reign, to defend his capital against the sultan of Egypt, who approached with a powerful army. His signal overthrow in the battle of Ascalon confirmed the stability of the Latin throne, and enabled Godfrey to extend on every side his infant kingdom, which consisted only of Jerusalem and Jaffa, with about twenty villages and towns of the adjacent districts. The fortified castles, into which the Mahommedans had taken refuge, and from which they made incursions into the open country, were reduced; the maritime cities of Laodicea, Tripoli, Tyre, and Ascalon, were besieged and taken; and the Christian kingdom thus included a range of sea-coast from Scanderoon to the borders of Egypt. "If the province of Antioch," says the Roman historian, "disdained his supremacy, the courts of Edessa and Tripoli owned themselves the vassals of the king of Jerusalem; the Latins reigned beyond the Euphrates; and the four cities of Hems, Hamah, Damascus, and Aleppo, were the only relics of the Mahommedan conquests in Syria."[1] The feudal institutions of Europe were introduced into this kingdom in all their purity; and a code of laws, called the assize of Jerusalem, was drawn up, which was attested by the seals of the king, the patriarch, and the viscount of Jerusalem, and deposited in the sepulchre of the Saviour, as an unerring guide in all doubtful questions that might be brought before the tribunals of the holy city.

Godfrey was succeeded in his great office by his brother Baldwin, who ruled with vigour and success. In 1118 his nephew ascended the throne, and still maintained the interests of the kingdom. Melisandra his daughter married Foulques of Anjou, who, in right of his wife, acquired the kingdom of Jerusalem. He lost his life by a fall from his horse, after having reigned ten or twelve years. His son, Baldwin III., ruled in Jerusalem twenty years; and his reign was remarkable as the era of the second Crusade, and of the rise of the various orders of knighthood, the hospitallers, templars, and cavaliers.

The military force of the first Crusaders, wasted by fatigue, and by losses in the field, was no longer able to oppose the hosts of Turks and Saracens by which it was surrounded. The first victories of the Europeans, and their rapid success, extended far and wide the terror of their arms. But this alarm having subsided, the Mahommedan chiefs collected their armies, and commenced a vigorous attack on the European posts, scattered over a wide extent of country, and gained some important advantages. The accounts of these disasters that were circulated in Europe excited the liveliest sympathy of all Christians for their suffering brethren in the Holy Land, for the defence of which the European princes now entered into a new coalition. A second Crusade was the consequence. It was undertaken forty-eight years after the deliverance of the holy sepulchre, by the emperor of Germany Conrad III., and Louis VII. king of France, and was even more unfortunate than the first expedition. In the course of a tedious march through an unhealthy and hostile country, more than half the army of Conrad was wasted by famine and the sword, and not above a tenth part ever reached the Syrian shore. The subsequent battles with the Saracens reduced them to a miserable remnant; and the emperor was met by Louis and the French troops, who arrived in better condition at the scene of action, on his return with his shattered forces from this unfortunate campaign. The French army, rashly advancing into the heart of the country, was assaulted and overwhelmed by an innumerable host of Turks; and the king with great difficulty made his escape, and finally took shipping with his knights and nobles, leaving his plebeian infantry to the sword of the victorious enemy. The two princes proceeding to Jerusalem, united the poor remains of their once mighty armies to the Latin troops in Syria, and laid a fruitless siege to Damascus, which was the termination of the second Crusade.

The defeat and dispersion of these armies tended greatly to weaken the Christian cause in the Holy Land, and shake the foundations of the Latin throne at Jerusalem. Baldwin, the son of Melisandra and of the Count of Anjou, together with his brother Amanry or Almeric, long maintained the war with considerable success against the infidels. Baldwin dying, was succeeded by his brother, who, after a reign of eleven years, transmitted the throne to his son Baldwin IV., disabled both in mind and body by the disease of leprosy. His sister Sybilla, the mother of Baldwin, was his natural heiress, who chose for her second husband, and consequently for king of Jerusalem, Guy of Lusignan, base in character, but handsome in his person. This choice was universally blamed, and excited the hatred of Count Raymond, who had been excluded from the succession and regency, and who, entertaining an implacable hatred against the king, was seduced into a traitorous correspondence with the sultan. Many of the barons were also so dissatisfied, that they refused to take the oath of allegiance to the new king. It was in the midst of these internal dissensions that the kingdom of the Latins was assailed by a new enemy, namely, the Sultan Saladin, who to valour, policy, and military skill, joined all the refined humanity of a Christian knight. He had risen from a private station to the sovereignty of Egypt, and he had been for years extending his influence and his dominions. A fortress had been seized by a soldier of fortune, Reginald of Chatillon, from which he issued with his followers to pillage the caravans and to insult the Mahommedans, and he even threatened the holy cities of Medina and Mecca. Saladin complained of these injuries, and being refused any satisfaction, invaded the Holy Land with an army of 80,000 horse and foot. He advanced against Tiberias, to which he laid siege; and a decisive battle was hazarded by the king of Jerusalem, in defence of this important place. The two armies met in the plain of Tiberias, and in a sanguinary conflict, which lasted two days, the Christians were completely overthrown, with the loss of 30,000 men, and a sacred relic, the wood of the true cross, with which the priests were wont to cheer the drooping spirits of the troops. The king, the Marquis of Montserrat, and the master of the templars, with many of their followers, were made prisoners; and two hundred and thirty gallant knights of the cross were cruelly led out to execution after the battle. This great victory placed the whole country at the mercy of the conqueror. The Christians were left without a head; of the two grand masters of the military orders, one was a prisoner, and the other slain. The fate of the kingdom had been set on a single cast, and its whole military force concentrated on this fatal field. The towns and castles, thus drained of their governors, fell successively before Saladin's victorious force; and scarcely had three months elapsed when he appeared in arms before the gates of Jerusalem.

This city was in no condition to sustain a protracted siege. It was crowded with fugitives from every quarter, who here sought an asylum from the destroying sword; a

[1] Decline and Fall of the Roman Empire, vol. xi. chap. lviii. p. 90.

disorderly throng of 100,000 persons was confined within the walls, but there were few soldiers; the queen was alarmed for the fate of her captive husband, and her government was feeble and indecisive. A defence was, however, maintained for fourteen days, during which the besiegers had effected a breach in the wall, and only waited the sultan's orders for the assault. This last extremity was averted by a capitulation, by which it was agreed that all the Franks and Latins should quit Jerusalem, receiving a safe conduct to the ports of Syria and Egypt; that the inhabitants should be ransomed for a sum of money, and that those who were unable to pay it should remain slaves. These conditions were liberally interpreted and greatly mitigated by the generosity of the sultan, who allowed the poor to be ransomed by wholesale for a moderate sum, and freely dismissed about 3000 more. In his interview with the queen, he displayed the kindness and courtesy of his disposition, comforting her with his words, and even with his tears; he distributed liberal alms among the widows and orphans of those who were slain, and allowed the warlike knights of the hospital to continue their care of the sick for another year. He made his triumphant entry into the city, with banners waving and martial music; the Christian church was converted into a mosque, and the glittering cross was taken down and dragged through the streets, amid the shouts of the Moslems. The whole country now submitted to the sultan, whose victorious progress was first arrested by the resistance of Tyre, which was gallantly defended by Conrad. The sultan, being foiled in all his attempts to take this place, was finally compelled to raise the siege, and to retreat to Damascus.

The capture of Jerusalem by the infidels, and the decline of the Christian cause in Palestine, excited the deepest sorrow; the decaying zeal of the European powers was awakened, and new expeditions were fitted out for the recovery of the holy city. About the year 1190, Philip king of France, the Emperor Frederick Barbarossa of Germany, and Richard I. of England, surnamed Cœur-de-Lion, assembled a large force, and, with the aid of Flanders, Frise, and Denmark, filled about 200 vessels with their troops. The first armaments landed at Tyre, the only remaining inlet of the Christians into the Holy Land, and no time was lost in commencing the celebrated siege of Acre, which was maintained with an enthusiasm that mocked at danger, and by feats of valour that were the theme of wonder, even in that romantic age. This memorable siege lasted for nearly two years, and was attended with a prodigious loss of men on both sides. Famine, misery, and the climate, wasted the besieging army, and still the besieged held out with enduring firmness. At length, in the spring of the second year, the royal fleets of France and England cast anchor in the bay, with powerful reinforcements, and the brave defenders of Acre were reduced to capitulate. A ransom was demanded for their lives and liberties, of 200,000 pieces of gold, the deliverance of 100 nobles, and 1500 inferior captives, and the restoration of the holy cross. Thus was an important town and harbour obtained by the Christians, but by an enormous sacrifice of men. The host that surrounded Acre amounted at different periods to 600,000; of these, 100,000 were slain during the siege of two years, a greater number perished by shipwreck and disease, and it is computed that a very small remnant ever reached their native shores. The place was taken possession of by the Christians on the 12th of July 1191.

The capture of Acre was the prelude to farther operations against the enemy. Richard determined to commence the siege of Ascalon, about a hundred miles distant, and his march to this place was a continual battle of eleven days. He was opposed by Saladin with an army of 300,000 combatants; and on this occasion was fought one of the most memorable battles of this or any other age. Saladin was defeated with the loss of 40,000 men, and the victorious Richard obtained possession of Ascalon and the other towns of Judea. A severe winter interrupted the operations of the field. But Richard, issuing from his winter quarters with the first gleam of spring, advanced with his army within sight of Jerusalem, the great object of his enterprise. Saladin had chosen Jerusalem for his head-quarters, when the sudden appearance of the Christian conqueror spread universal consternation. The holy city was however relieved by the hasty retreat of the English king, discouraged by the difficulties of the enterprise and the murmurs of his troops. In the mean time the town of Jaffa was vigorously assaulted by Saladin with a formidable force, and was on the point of surrendering, when Richard, flying to its relief, encountered the besieging army of Saracens and Turks, amounting to 60,000 men, who yielded to the vigour of his attack. In the mean time the miseries of a protracted war began to be severely felt, and the ambitious views of Richard were obstructed by the discontent of his troops. Negotiations were commenced, which were broken off, and as often resumed. The views of both parties varied with the fortune of war. At last, however, both Saladin and Richard were equally desirous of terminating an unpopular and ruinous contest. The first demands of Richard were the restitution of Jerusalem, Palestine, and the true cross. These terms were rejected by the sultan, who would not part with the sovereignty of Palestine, or listen to any proposition for dismembering his dominions. A truce was at length concluded for three years, by which it was stipulated that the Latin Christians should have liberty to visit the holy city without being liable to tribute; that the fort of Ascalon should be dismantled; and that Jaffa and Tyre, with the intervening territory, should be surrendered to the Europeans. Soon after the conclusion of this treaty Richard embarked for Europe; and Saladin, his great rival, did not survive many months the conclusion of peace. He died at Damascus in the year 1193; and before he expired he gave orders that his winding-sheet should be carried as a standard through every street of the city, while a crier went before and proclaimed with a loud voice, "this is all that remains of the mighty Saladin, the conqueror of the East."

The fourth Crusade was encouraged by the zeal of Pope Celestine III. It was directed against the Greek empire, which was too feeble to resist so formidable an attack; and the result was its conquest by the Latins, who ruled over it for fifty-seven years.

In the mean time, in Palestine, though partial successes were gained by the armies of the Crusaders, their power was on the decline. A truce had been concluded with Saphadim, the brother and successor of the Sultan Saladin, for six years. The sovereign of the Latin kingdom at this time was Mary, the daughter of Isabella by Conrad of Tyre, Almeric and his wife being dead. In order to strengthen the government of Jerusalem, it was resolved to request the king of France, Philip Augustus, to provide a husband for Mary. John de Brienne, one of the most accomplished cavaliers in Europe, of tried valour and experience in war, was chosen; and the Christian chiefs were so elated by this union, that they sought a pretence for breaking the subsisting truce between them and the sultan, and bringing matters to the arbitration of the sword. War accordingly ensued, and the new monarch of Jerusalem displayed all the great qualities of a statesman and a soldier, for which he was chosen; and though his success did not entirely correspond to his hopes or wishes, yet he made a successful defence, and maintained for a time the Latin kingdom against the growing power of its enemies. He foresaw, however, that its gradual decline and final ruin was approaching, being now reduced to two or three

Palestine. towns, and preserved only in a precarious existence by the divisions and civil wars that prevailed among its enemies.

This intelligence rekindled the dying zeal of the Christian world. A new Crusade was commenced, and in 1216 a large force, chiefly of Hungarians and Germans, landed at Acre. The sons of Saphadim, who now ruled in Syria, collected their armies to oppose this formidable attack. But the Crusaders, rashly conducted, and weakened by divisions, advanced into the country without concert or prudence; provisions failed them; they were wasted, as usual, by famine and disease; and at length their leader, the sovereign of Hungary, resolved to quit a country where he had been exposed to hardship and danger, without glory. The crusading armies, thus weakened and discouraged, had laid aside all further idea of offensive operations, when, in the spring of the following year, a fleet of 300 vessels, that sailed from the Rhine, appeared on the coast, and brought to their aid powerful reinforcements, that recruited their strength, and restored their ascendency in the field. For reasons that do not clearly appear, they now retired from Palestine, and carried the war into Egypt, where they obtained important successes, having taken Damietta by storm, and spread such consternation among the infidels, that the most favourable terms of peace were offered, and rejected by the Crusaders, who, having wasted their strength on the banks of the Nile, were reduced to the necessity of bargaining for permission to retire to Palestine, by the cession of all their conquests in Egypt.

The next Crusade was undertaken by Frederick II., the grandson of Barbarossa, according to a vow which had been long made, and the performance of which had been so long delayed that he was excommunicated by Gregory IX. By his marriage with Violante, the daughter of John de Brienne, he was the more especially bound to vindicate his right to the kingdom of Jerusalem, which he had received as a dowry with his wife. After many delays, he set sail with a fleet of 200 sail and an army of 40,000 men, and in the year 1228 he arrived at Acre. This was the most successful and the most bloodless expedition that had yet been undertaken. Without the hazard of a battle he entered Jerusalem in triumph. The Saracen power was at this time weakened by divisions; and, owing to suspected treachery among his kindred, the son of Saphadim held rather a precarious possession of the throne. It was his policy, therefore, rather to disarm the hostility of these powerful armies by treating with them, than to encounter them in the field; and accordingly a treaty was concluded, by which Jerusalem, Jaffa, Bethlehem, Nazareth, and their dependencies, were restored to the Christians; religious toleration was established, and the contending parties of Christians and Mahommedans were allowed each to offer up their devotions, the first in the temple of Solomon, and the last in the mosque of Omar. But all these services were performed by Frederic while under the stain of excommunication; and hence the patriarch, when he made his entry into Jerusalem, refused to crown him, or to be present at the ceremonial; and Frederic himself took the crown from the holy sepulchre, and placed it on his own head. The stipulations of this treaty were not faithfully observed by the Saracens, and the Christians in Palestine still suffered under the oppression of the infidels. New levies were raised in Europe for the holy war, and a large force of French and English, led by the chief nobility of both nations, landed in Syria in 1239. Numerous battles were fought, which terminated in favour of the Saracens; and the French Crusaders, accordingly, after severe losses, were glad to purchase peace by the cession of almost all their conquests in Palestine. Next year, when the English levy under the Earl of Cornwall arrived at the scene of action, he found, to his surprise, that all the territories and privileges that had been ceded to the emperor of Germany were lost; and that a few fortresses, and a small strip of territory on the coast, comprised all that the Latins possessed in Palestine. He immediately prepared for the vigorous prosecution of hostilities. But the sultan, being involved in war with his brother in Damascus, readily granted favourable terms as the price of peace, namely, the cession to the Christian armies of Jerusalem, Beritus, Nazareth, Bethlehem, Mount Tabor, and a large tract of the adjoining country. But the kingdom of Jerusalem, thus so happily established, was subverted by a calamity from a new and unexpected quarter. In the interior of Asia the conquests of Ghenghis Khan had brought about the most stupendous revolutions, and the barbarous hordes of the desert, flying before his conquering sword, rushed like a torrent on other nations. The Kharismians, unable to withstand this powerful invader, were driven upon Syria, and the coalesced powers of Saracen and Christian were unable to resist their powerful assault. The Christian host was overthrown in a great battle, which lasted two days, and in which the grand masters of two orders, and most of the knights, were slain. The merciless invaders revelled in the sack and pillage of the holy city, sparing neither sex nor age; and it was not until the year 1247 that they were routed near Damascus, by the Syrians and Mamlouks, and driven back to their former settlements on the Caspian Sea.

Each new disaster of the Christian arms served to rekindle the languishing zeal of the Europeans; and Louis IX. of France fitted out an immense armament for the Holy Land, consisting of 1800 sail of vessels, in which he embarked an army of 50,000 men. He landed in Egypt, and after storming the town of Damietta, he advanced along the sea-coast towards Cairo, when his troops were so wasted by sickness and famine that they fell an easy prey to the enemy. The king, with most of his nobles, and the remnant of his army, were made prisoners; and it was owing to the clemency of the sultan, who accepted a ransom for their lives, that Louis, with his few followers who remained alive, was permitted to embark for Palestine.

The power of the Christians in Palestine, weakened, among other causes, by internal dissensions, was now vigorously assailed by the Sultan Bibars, the Mamlouk sovereign of Egypt. He invaded Palestine with a formidable army, advanced to the gates of Acre, and reducing the towns of Sephami and Azotus, massacred or carried into captivity numbers of Christians. The important city of Antioch yielded to his powerful assault, when 40,000 of the inhabitants were put to the sword, and 100,000 carried into captivity. The report of these cruelties in Europe gave rise to the ninth and last Crusade against the infidels, which was undertaken by Louis, the French king, sixteen years after his return from captivity. But, in place of directing his arms immediately against Palestine, he landed in Africa, and laid siege to Carthage, which he reduced. But he perished miserably on the burning sands of Africa, of a pestilential disease, which proved fatal also to many of his troops; and thus ingloriously terminated this expedition, which was the last undertaken by the Europeans for the recovery of the Holy Land.

The Europeans in Palestine, a feeble remnant, were now confined within the walls of their last stronghold, which was besieged by a Mamlouk host of 200,000 troops, that issued from Egypt, and encamped on the adjacent plain. In this their last conflict with the infidels of the Holy Land, the Europeans fully maintained the glory of their high name. They displayed all the devotion of martyrs in a holy cause, and performed prodigies of valour. But, equalled as they were in discipline, and fearfully overmatched in numbers, by their enemies, they were overborne by the weight and violence of their attacks, and in the storm and sack of the city all either perished or were carried into captivity. Thus terminated for ever all those visions of glory and conquest by which so many adventurers were seduced from Europe to the Holy Land, there to perish under the complicated perils of disease and the sword. The historian of Rome describes, with his usual force and eloquence, the last struggle of the Europeans in defence of Acre. "Whatever," he observes, "might be the vices of the Franks, their courage was rekindled by enthusiasm and despair; but they were torn by the discord of seventeen chiefs, and overwhelmed on all sides by the power of the sultan. After a siege of thirty-three days, the double wall was forced by the Moslems; the principal towers yielded to their engines; the Mamlouks made a general assault; the city was stormed; and death or slavery was the lot of 30,000 Christians. The convent, or rather fortress, of the templars resisted three days longer; but the grand master was pierced with an arrow, and, of 500 knights, only ten were left alive, less happy than the victims of the sword, since they had to suffer on the scaffold in the unjust and cruel proscription of the whole order. The king of Jerusalem, the patriarch, and the great master of the hospital, effected their retreat to the shore; but the sea was rough, the vessels were insufficient, and great numbers of the fugitives were drowned before they could reach the isle of Cyprus. By the command of the sultan, the churches and fortifications of the Latin cities were demolished; a motive of avarice or fear still opened the holy sepulchre to some devout and defenceless pilgrims; and a mournful and solitary silence prevailed along the coast, which had so long resounded with the world's debate." The other smaller towns which still remained in possession of the Christians yielded without a struggle to the Moslem arms, and, under the religious tyranny of the infidels which succeeded, the Christians in Palestine were everywhere reduced to the lowest degree of debasement. The pilgrims who still visited Jerusalem were exposed to insult and danger; and large contributions were exacted by their oppressors for a free passage through the Holy Land. The Mamlouk sultans of Egypt continued to rule over Palestine till the year 1382, when the country was overrun by a barbarous tribe from the interior of Asia. On their expulsion the sovereignty of the Egyptian sultans was again acknowledged, until the country yielded to the formidable irruption of the great Tamerlane. At his death Jerusalem reverted to the kingdom of Egypt, and was finally subdued by Selim IX. the sultan of the Turks, under whose barbarous regime it has continued for more than 300 years. The country was partitioned into provinces, in each of which a pasha ruled with a despotic authority equal to that of the sultan.

In this condition Palestine remained without any remarkable event in its history, except that for nearly three centuries it was the scene of domestic broils, insurrections, and massacres, until the memorable invasion of Egypt by the French army in 1799. Bonaparte, being apprized that preparations were making in the pachalik of Acre for attacking him in Egypt, resolved, according to his usual tactics, to anticipate the movements of his enemies. He accordingly marched across the desert which divides Egypt from Palestine, and invaded the country at the head of 10,000 troops. El Arish surrendered, and the lives of the garrison were spared on condition that they should not serve against him during the war. Gaza also yielded without opposition; and Jaffa, stormed after a brave resistance, was given up to pillage. And here, in opposition to every feeling of humanity, and to all the maxims of civilized war, was exhibited a scene of atrocity, in the massacre, in cold blood, of 4000 prisoners, which vies in cruelty with the darkest deeds of savage life, and has left an indelible stain on the character of the chief agent, and all his accomplices, in this bloody transaction. The plea, that these prisoners were dismissed at Jaffa on the understood condition of not again serving during the war, and that, having violated this condition, they were liable to death, was not supported by any evidence. It was not proved that those who surrendered at Jaffa were the same persons who were dismissed at El Arish; and the story seems indeed to have been fabricated, as the best apology that could be offered for such unheard-of cruelty, after the murder was committed. In the circumstances in which he was placed, those prisoners were a most inconvenient encumbrance to the French general; of which, accordingly, he appears to have freed himself by the short process of a general massacre.

The French army proceeded without delay to form the siege of Acre; and this fortress, the last scene of conflict between the Christians and infidels of former days, became a modern field of battle, in which were exhibited prodigies of valour that rivalled the most renowned deeds of those chivalric times. Bonaparte, though a French convoy with battering cannon and stores for the siege had been captured by a British squadron under Sir Sidney Smith, still persevered in his resolution to reduce the place. The trenches were opened on the 10th of March; in ten days a breach was effected, and a desperate assault took place. For a time the garrison were overpowered, and gave way; but Djezzar Pasha, who had shut himself within the walls, and who was aided by Sir Sidney Smith with a body of British sailors, rushed forward among the thickest of the combatants, and, animating the troops by his example, drove back the enemy with heavy loss. Bonaparte still persevered in a series of furious assaults against the fortress, which were all most gallantly repelled; and after a protracted siege of sixty days, a last assault was ordered, which was equally unsuccessful with all former attempts, and was attended with the loss of some of his bravest warriors. This last failure dictated the necessity of an immediate retreat, which was accomplished with difficulty, in a tedious march through the burning desert, where hardship and privation of every sort was the lot of the wayworn soldier, and the sick and wounded were left in most cases to inevitable death. The French army was attacked during the siege by a powerful body of Turkish troops; and a detachment under Junot, in an engagement which took place near Nazareth, would have been cut to pieces by the Mamlouk cavalry, but for the timely aid of Napoleon. Kleber also, surrounded by an overwhelming body of the same formidable cavalry near Mount Tabor, and who by his presence of mind and military skill had kept the enemy at bay during a whole day, was saved by the artillery of Napoleon, which speedily scattered this cloud of horsemen over the face of the desert.

Of late years a new power has arisen in the East, namely, that of the viceroy of Egypt, who having collected large treasures and a well-disciplined army, openly renounced his allegiance to the grand signior. A war took place, in which the hasty levies of Turkey were broken and put to flight by the veteran troops of Egypt; and a series of brilliant successes fully established the independence of the viceroy. As the price of peace, large districts in Syria and Palestine were ceded to him. We have no certain accounts whether these countries have improved under his sway; but the levies which he imposed on them, of men and money, have, it appears, been severely felt, as the country has been the scene of insurrections which have been with difficulty quelled by his troops. His government is, however, an improvement on the tyranny of Turkey; and in time we may hope that the country will reap the fruits of his wiser policy. (F.)

PALESTRINA, a town of Austrian Italy, in the province of Milan, and delegation of Venice. It is rather a village than a town, being situated on an island at the mouth of the river that stretches from Porto di Chioggia to Porto di Malomocco, a distance of nearly fourteen miles. It contains 5980 inhabitants.

PALEY, WILLIAM, D. D., was born at Peterborough in July 1743, where his father was then minor canon of the cathedral church. His father afterwards removed to Giggleswick, being appointed head master of the school at that place. Here his son was trained under his immediate inspection, and discovered a solidity of understanding, and a studiousness of disposition, which gave a fair earnest of his future eminence.

In November 1758, at the age of fifteen, he was admitted a sizar of Christ's College, Cambridge, and in October 1759 he became a resident member. When he left home his father could not refrain from expressing to his friends the anticipations he entertained of the figure which his son was destined to make: "He'll turn out a great man; very great. He has by far the clearest head I ever met with."

Shortly after his removal to Cambridge he obtained three scholarships. He was not at this time a close or laborious student; he spent much time in company, and improved himself rather by observation and reflection than by reading. When he appeared in the public school to make his first *act*, the spruceness of his dress, presenting a striking contrast to the habitual carelessness of his appearance, attracted very particular notice, and, aided by a singularity in his gestures and manner, occasioned much mirth amongst the spectators; but the uncommon success with which he acquitted himself had the effect of drawing crowds on all future occasions when he was expected to dispute. His eminent abilities created upon one occasion some degree of apprehension, when he proposed to argue against the eternity of future punishments. One of the heads of the college insisted on his relinquishing that question. Dr Watson, then moderator, and afterwards the celebrated Bishop of Llandaff, protected on this occasion Paley's independence. The latter, however, was averse to give offence; and at the suggestion of Dr Watson he retained the subject, but took the opposite side. He came off with much eclat, his talents having received the best scope for display from the high ability of his opponent, Mr Frere.

After obtaining with great honour his bachelor's degree in January 1763, he accepted of the situation of second assistant and Latin teacher in an academy at Greenwich, chiefly resorted to by young men intended for the army and navy.

In 1765 Mr Paley gained the first senior bachelor's prize by a Latin dissertation on "a Comparison between the Stoic and Epicurean Philosophy in their influence on Morals;" taking the side of the Epicureans, as a sect friendly to rational pleasures, and not, as their enemies supposed, indulgent to vicious excesses; whilst he condemned the affected austerity of the followers of Zeno, and showed from facts that it was compatible with the most flagitious crimes. It is a remarkable circumstance, as illustrative of the formality which often presides in university matters, that this dissertation narrowly escaped rejection, because the Latin text was accompanied by *English notes*, for the purpose of aiding philosophical accuracy where the Latin appeared liable to ambiguity.

Being ordained deacon at the proper age, he officiated as curate to Dr Hinchcliffe, vicar of Greenwich, where he continued to reside, though he gave up his situation in the academy.

Mr Paley was elected a fellow upon the foundation of Christ's College in June 1766; returned to reside in the university; took the degree of master of arts, and engaged in the business of private tuition. He took priest's orders in December 1767, and in 1768 he was appointed tutor of Christ's College, along with his friend Mr Law, already a distinguished scholar. The talents and assiduity of these two quickly raised the celebrity of their college to an unprecedented height. Paley's intimacy with Law was productive of much mutual improvement, and introduced the former to the acquaintance of his friend's father, the eminent Dr Edmund Law, who was soon after Bishop of Carlisle, but continued to reside in the university as master of Peterhouse. Mr Paley was at this time held in the highest esteem; and amongst his particular friends were numbered Dr Plumptre, professor of casuistry; Dr Waring, Lucanian professor of mathematics, who was in his department eminent beyond his contemporaries; and the accomplished Mr Jebb. He figured as a lecturer on mathematics, morals, and the Greek Testament, and afterwards on divinity. His method of lecturing was singularly happy, the result of a diligent study of the art of teaching. He soon discovered that, in moral disquisitions, more pains are required to make young minds perceive the difficulty than to make them understand the solution, and that some curiosity must be raised before an attempt is made to satisfy it. The discourses which he delivered at this time contained the germ of the principal works which he afterwards published on morals and theology.

The controversy on the propriety of requiring a subscription to articles of faith, as practised by the Church of England, was at this time much agitated at the two universities. At Oxford the High Church party was triumphant, and scarcely any individual ventured a whisper of opposition; but at Cambridge, talents and ingenuity were exercised upon both sides of the question. Paley favoured the claims of the reforming party; but, from motives of prudence, declined signing a petition for relief at that time drawn up, not entertaining such expectations of ultimate success as to be induced to take a public step so obnoxious to those on whom his future prospects depended. He told one of his friends in jest, that "he could not afford to keep a conscience;" a confession which will, no doubt, lay him open to the animadversions of those who reserve their censures for the subdued struggles of a mind of limited moral strength, whilst they excuse or applaud the oppressive system by which its efforts are overawed. Paley, however, soon after wielded his pen in a decided tone in the cause of freedom. Dr Law, the bishop of Carlisle, published an able and moderate pamphlet against the imposition of the church test. An answer appeared at Oxford from the pen of Dr Randolph. To this Paley published, anonymously, a reply, entitled A Defence of the Considerations on the Propriety of the Church Test.

His well-merited reputation induced that great constitutional lawyer, the Earl of Camden, to offer him the situation of tutor to his son; but his other engagements led him to decline the offer.

In 1775, he was inducted to the rectory of Musgrove in Westmoreland, worth about eighty pounds a year, presented to him by the Bishop of Carlisle. He now married Miss Hewit of Carlisle, and took a small farm to improve his income; a speculation which he soon after gave up as unproductive. Next year, he was inducted to the vicarage of Dalston in Cumberland.

In 1777, he was inducted to the vicarage of Appleby, worth about L.200 a year; and whilst in this situation he published a small volume, entitled The Clergyman's Companion in Visiting the Sick; in which he both evinced his personal attention to the spiritual wants of his own flock, and conferred an obligation on his brethren, which has been acknowledged by the numerous and large editions which it has undergone. In June 1780, he was installed a prebendary of the fourth stall, in the Cathedral of Carlisle, worth about L.400 a year; and in August 1782, on the promotion of his friend Mr Law to the see of Clonfert, he was raised to the dignity of archdeacon of the diocese.

A report was long in circulation, that Mr Paley, being appointed to preach before the University of Cambridge when Mr Pitt made his first appearance at St Mary's after his elevation to the premiership, chose the following passage for his text: "There is a lad here who hath five barley loaves and two fishes; but what are they among so many?" That was not the fact; but the joke originated with Paley, who said to a friend that, had he been asked to preach on the occasion, he would have chosen this text.

Now in possession of a competent income, and sufficient leisure, he prepared for the press his great work On the Principles of Moral and Political Philosophy, which first appeared in 1785. In consequence of the well-known merit of his lectures on the subject of that work, high expectations were formed of it; and his admirers were not disappointed. Its most obvious feature was that of being all directed to the practice of life in cases which hourly claim the attention of well-meaning minds. Most other scientific works on morals were mere speculative treatises, which pleased the reader by unfolding the principles of right and wrong, in cases in which he has been previously satisfied about the practical rule and its application; whilst they embarrassed conscientious inquirers with hair-breadth distinctions, instead of conveying satisfactory principles. Dr Paley's work happily unites a due regard for practical duty with rational information on those points on which the mind is most anxious to obtain satisfaction. It soon established the reputation of its author. Some of his doctrines met with opposition, but he never was provoked to write any reply; and it is further remarked by his biographer, Mr Meadley, that, in the subsequent editions, he made no alterations materially affecting the sense. Had there been a few such alterations, however, he would have more fully merited the character of a liberal inquirer. Amongst his elucidations of the foundations of virtue, he certainly fails in his definition of "the nature of obligation." He acknowledges that the subject had embarrassed his own mind; yet he ultimately reposes in a solution founded on a confusion of terms, which laid him fully open to the animadversions of the Reverend Mr Pearson, who published An Examination of his Theory. Dr Paley's doctrine is, that "a man is under moral obligation when he is urged by a violent motive resulting from the command of another." He thus resolves obligation into an effectual inducement. According to this statement, a man is under no moral obligation unless he feels, acknowledges, and acts upon it. Had such a hypothesis occurred in the writings of an author who made the purity of practice to depend on the reception of peculiar theories, it might have created great laxity of principle in the minds of some persons, and distress in those of others. But his masterly elucidation of the rule of morals, and the paternal benignity with which his efforts are uniformly accompanied, set his reader at rest from all hurtful anxiety on practical topics.

His exposition of the rule of morals, as founded in utility, is ably managed. He demonstrates the superiority of this rule to every other, and the subordinate rank of all those mental suggestions and impressions which some moralists have represented as essential parts of the foundation of morality. Many such feelings are valuable provisions of the Author of our Nature, but they do not deserve the authority of guides. Their whole claim to our obedience is derived either from their coincidence with some express command of the Deity, or their conduciveness to utility. The difficulties attending inquiries into this conduciveness in particular instances do not generate uncertainties so great as those attached to the other supposed natural tests of moral truth. A man may be mistaken respecting the useful or hurtful *tendency* of a particular line of conduct; but he is equally liable to be led astray by feelings venerated as moral suggestions; and, under that influence, he is deprived of an equal possibility of correcting himself by subsequent reflection. When authors declaim on the danger attached to the doctrine of utility, they borrow their arguments from that doctrine itself. They merely set up utility in its extensive application against such utilities as are partial and delusive. Dr Paley, therefore, dwells strongly on the necessity and importance of *general rules;* and, by taking them for his guides, obviates all the serious objections brought against this leading theorem, "that the method of coming at the will of God concerning any action, by the light of nature, is to inquire into the tendency of that action to promote or diminish the general happiness."

On our duties to ourselves his observations are short, at which we cannot be surprised when we find that in his definition of virtue these duties are excluded. In the excellent casuistical Observations on Self-Defence, Drunkenness, and Suicide, of which this portion of his work entirely consists, he regards the tendency of personal conduct and habits only as they affect society around us. But if he had paid more respect to the maxims of the stoical authors, and studied them in their most favourable meaning, he would have been more disposed to point out the importance of maintaining mental composure as an ultimate object of individual efforts. On our duties towards God he also treats briefly. The simplicity attached to our knowledge of their great object divests them of variety as a separate subject, without detracting from their sublimity.

In the political part of this work, we find the exertions of a manly understanding employed with some success in exposing the dark bigotry and the gratuitous king-worship by which political knowledge had in past ages been disgraced. His efforts, however, are exempt from those headstrong tendencies which minds liberated from unfair control sometimes betray, and thus run into schemes incapable of being applied without compromising the happiness of society. That happiness he keeps steadily in view, as the only legitimate object of all government, as well as the only legitimate object of opposition to existing practices and institutions. Some of his admirers consider him as going too far in vindicating the exaction of a subscription to the Thirty-nine Articles. His chapter on subscription has been assailed with equal asperity by the strenuous adherents of the established church, and by the scrupulous advocates of Protestant freedom. His biographer, Mr Meadley, calls it "the last effort of an ingenious mind to soften, by interpretation, the rigour of a practice of which he could not seriously approve, and so to enlarge the pale of conformity to liberal and conscientious men."

The answer which he gives to the arguments for passive obedience as founded in Scripture, is particularly worthy of attention. Throughout the whole he displays a candour of the most conciliating kind. None of his strictures on existing systems had the slightest tendency to give offence to any, except to persons actuated by downright prejudice, or the most corrupt motives.

On the death of Dr Law, bishop of Carlisle, which happened in 1787, Mr Paley published a short Memoir of the life of that venerable prelate. Soon afterwards he wrote two tracts in favour of "the abolition of the slave-trade;" a subject on which he had expressed his sentiments with decision in his Principles of Moral and Political Philosophy, before it began to excite general interest.

In 1790 he published his *Horæ Paulinæ*, or the Truth of the Scripture History of St Paul evinced, by a comparison of the Epistles which bear his name, with the Acts of the Apostles, and with one another. The object was to show, by a copious selection of references and reciprocal

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allusions, the strong evidence of their genuineness derived from their undesigned coincidence. This able treatise possesses more novelty of interest, and greater originality of idea, than any of his other works.

During the violent political ferment which led to the French Revolution, Dr Paley published a short tract, entitled Reasons for Contentment, addressed to the Labouring Classes; and he republished, in a separate form, his chapter on the British Constitution, from his Principles of Moral and Political Philosophy. He was censured by the violent partisans on both sides, as he went the full length of neither; but his style of reasoning had the best tendency to guide and satisfy those minds which were not obstinately and unreasonably prepossessed.

In May 1791, Mrs Paley died, leaving him a family of four sons and four daughters.

Early in 1794 he published his View of the Evidences of Christianity. This work, with regard to manner and effect, follows a happy medium between that learned prolixity which deters the reader, or tires out his patience, and that abrupt brevity which is apt, with some minds, to beget an unfortunate impression of some imperfection in the argument. He contends for the substantial truth of the history connected with the Christian revelation; and, not undervaluing, as some have injudiciously done, the internal evidences, he exhibits, in primitive simplicity, and without the least oratorical exaggeration, the superlative value of those doctrines in which all Christians are agreed, and gives an animated view of the morality of the gospel. The work, considered as addressed to doubting minds, was well fitted to interest the attention of all who are duly impressed with the importance of the question at issue.

Hitherto his preferment in the church had been slender, considering his singular merit and the opulence of the ecclesiastical establishment. But the boldness of his reasonings on political subjects had given deep dissatisfaction. To the favourers of power it was not welcome doctrine, that "governments may be too secure;" that "the obligations of subjects and sovereigns are reciprocal;" and "that the divine right of kings rests on the same foundation with the divine right of constables." But when he stood forth as the successful defender of the Christian revelation, at a time when the interests of the church were supposed to be in danger, his services met with more marked attention. Dr Porteous, bishop of London, conferred on him the desirable situation of prebend of St Pancras in the Cathedral of St Paul's, to which he was instituted in August 1794. He was in a few months afterwards promoted to the subdeanery of Lincoln by Dr Prettyman, bishop of that diocese, and took his degree of D. D. at Cambridge.

Before leaving this place, he had the agreeable surprise of a letter from Dr Barrington, bishop of Durham, offering him the valuable rectory of Bishop-Wearmouth, worth about L.1200 a year, into which he was soon inducted. A few months afterwards he married Miss Dobinson of Carlisle; and, from this period to his death, divided his time between Bishop-Wearmouth and Lincoln, being obliged to reside three months in the year at the latter place. Now that he enjoyed a handsome independence, we find his company courted by many distinguished characters, and his life spent in a series of the most useful labours, whilst all his secular transactions were so well conducted, as to shed a lustre on his character, and to exhibit a most instructive example to all around him. Both his parents lived to witness his high reputation and success in life. His mother died in 1796, and his father in 1799.

In 1800, Dr Paley was attacked by a disease in the kidneys, accompanied with a species of melæna, which obliged him to suspend the discharge of his professional duties. He had a second attack in the following spring, and a third about the end of 1802.

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During the progress of this fatal disease, he was engaged in preparing for the press his last important work, On Natural Theology. His literary labours were frequently interrupted by severe paroxysms of pain, but on the first respite he always resumed them with cheerfulness. Under these circumstances, he wrote his excellent remarks on the alleviations of pain, in his chapter on the Goodness of the Deity. This work had been undertaken at the suggestion of the Bishop of Durham, that he might, by theological exertions in his closet, make up for the unavoidable suspension of his public ecclesiastical labours. In none of his writings does his candour appear to such incontestible advantage as in this. We never find him browbeating the adversary, or attempting to push his conclusions a single step farther than his premises evidently warrant. We do not find him, like many others, advancing the metaphysical position "that every thing which exists must have a cause," so glaringly open to the query, "why should the world have a cause more than its Creator?" Mere existence cannot authorize the inference of owing that existence to a higher source. He rests his argument on far better ground; the *character* of the fabric of nature, or rather of various objects in it which offer themselves to our observation. Nor does he, with some, assume the doctrine, that matter is essentially inert, and that, therefore, its motions must be induced by an extraneous and spiritual cause. He more wisely turns his attention to the proofs of *design* which so many objects in the world exhibit. These are so selected and arranged as to appear in the most interesting and satisfactory point of view. Where the phenomena are apparently inconsistent, we find no straining to reconcile them; no reluctance to take a full view of unfavourable appearances; no inclination to draw the same inferences from opposite facts. His argument is not suspended on a chain of metaphysical reasoning, which would have subjected it to the risk of destruction as soon as one of the links gave way. He directs the attention of his reader to numerous columnar supports of the existence of a God, each of which is adequate to the whole office. Each instance produced is decisive of the point at issue; and though his instances are numerous as well as beautiful, they are evidently only partial exemplifications of a species of evidence which is boundless in extent.

In the present state of the learned world, this is perhaps the most important of Dr Paley's works; as possessing the best tendency to reclaim persons wandering in the mazes of scepticism, to that state of thought which is most favourable to the true improvement of the human character; and to the establishment of that state of mental peace after which a sense of our weakness naturally leads us to aspire.

After its publication, Dr Paley continued to take a lively interest in the literary and scientific discussions of the day, especially such as bore directly on the great interests of society; but in May 1805, he was subjected to a violent attack of his complaint, in which all remedies proved ineffectual; and, with great tranquillity, he breathed his last at Bishop-Wearmouth, leaving a family of four sons and four daughters in possession of a competent fortune, saved by a systematic though by no means a niggardly economy.

He wrote several sermons and other minor productions, less known than those above enumerated. They are all collected in a uniform edition of his works, and will be found, on examination, worthy of his fame, and successfully directed to the same valuable ends with his more celebrated productions. (P. P. P. P.)

PALFREY is one of the better sort of horses used by noblemen or others for state, and sometimes of old taken for a horse fit for a woman to ride.

PALGUNGE, a town of Hindustan, in the province of Bahar, and district of Monghir, 122 miles south-east from Patna. Long. 86. 15. E. Lat. 24. 5. N.

PALHAUNPOOR, a town of Hindustan, in the province of Gujerat, and district of Dandur. Long. 72. 35. E. Lat. 24. 44. N.

PALICAUDCHERRY, a town of Hindustan, in the province of Malabar. In the year 1766, Hyder Ali gave orders for building here a strong stone fort, which might serve as a point of communication between his new conquests and his fixed resources in the district of Coimbetoor. It is situated in the middle of the teak forests, on the bank of the Paniany River, by which, during the rainy season, any quantity of wood may be floated down to the seaport of Paniany, and from thence conveyed to Bombay or Ceylon. Around the fort are scattered many villages, estates, and bazaars; but there is little appearance of a town. The surrounding district contains 123,074 inhabitants. It was ceded to the British by Tippoo in 1792. The fort is 110 miles south from Seringapatam. Long. 76. 50. E. Lat. 10. 50. N.

PALIMPSEST, in Greek παλιμψηστος (a word formed from παλιν, *again*, and ψαω, *to wipe, cleanse*, or *rub*), is a term applied to a manuscript, from its having been twice cleaned, or twice written, that is, *rescribed*.

The value of ancient manuscripts has long been rightly estimated, and hence in every part of Europe they have been collected at great expense, and preserved with the utmost care. For some time after the invention of printing, it was indeed thought that when the contents of a manuscript had been copied, and multiplied by means of that invaluable art, the original was rendered useless. But as different manuscripts of the same work often vary in particular readings, it was soon found necessary to examine and collate a number of them, in order to ascertain the preferable readings; and without this previous care, conjoined with critical discrimination, a new edition of an ancient work would not now be well received by the learned. Such, then, is the most direct and obvious use of ancient manuscripts; which, when duly collated, furnish the means of restoring texts that had been corrupted or mutilated in the course of frequent transcription.

But, on a more minute examination of a certain class of manuscripts, it appeared that some of them might have a value hitherto unsuspected, by supplying more ancient copies than were previously known, and even furnishing portions of important works which were supposed to be entirely lost. These were manuscripts in which an attempt had been made to obliterate some more ancient writing, that the parchment might be again used to receive another work. This practice was not uncommon in the darker ages, both before and after the thirteenth century, when the material was scarce and dear, and the older works were either not understood or not duly appreciated. But, happily, the endeavour to rub out or obliterate the original writing had sometimes so far failed, that an attentive eye could, with more or less difficulty, discover traces of the older letters, and even decipher words; and certain manuscripts of respectable antiquity were thus found to conceal others several centuries older, and frequently of much superior interest and value. Manuscripts of this kind, therefore, received from the learned the name of *Palimpsest* or *Rescribed*, and became objects of curious and interesting investigation.[1]

This term was not unknown to the ancients; but they applied it chiefly to leaves or books which were so prepared that one writing could easily be expunged to make room for another, and which were used by authors for correcting their works, or submitting them to revision. In this sense, palimpsests are mentioned by Cicero, Plutarch, and Catullus; and the poet, in particular, ridicules a bad author for not writing his works at first on palimpsests, but entering them at once, crude and uncorrected, in fine and costly books. But the palimpsests now to be considered are of much superior importance. They have opened to us some great discoveries, and given promise of many more. Some invaluable fragments of ancient works, believed to be entirely lost, have already been recovered; and the hopes which may fairly be entertained of future acquisitions from the same source, will best be estimated by a short account of what has actually been effected in exploring it.

The first rescribed manuscript of which any important use was made appears to have been the *Codex Ephrem* or *Codex Regius* of Paris.[2] The more modern writing in this manuscript contains certain works of Ephrem the Syrian, in Greek; the more ancient seems to have contained the whole of the Old and New Testament, in a character and style of Greek writing which the best critics have assigned to the sixth or seventh century. Of this manuscript there are 209 leaves remaining, but so miserably confused and misplaced, and with so many chasms of various kinds, that sometimes scarcely a word can be deciphered in a whole leaf. But the difficulties occasioned by these defects and mutilations have not deterred critics from endeavouring to make the most of the *Codex Ephrem*. From it Kuster first obtained several readings; and Wetstein afterwards collated, with great diligence, all that it contains of the text of the New Testament. Griesbach considers this as the most ancient manuscript collated by Wetstein; and there can be no doubt that the readings thus obtained confer a particular value on his edition. How much of the Old Testament may remain in this *codex* has not yet been ascertained, nor has that part of it been collated, even for the Oxford Septuagint; a circumstance at which Griesbach expressed his surprise when he published the first part of his *Symbola Critica*.[3] This valuable palimpsest was originally pointed out for critical examination by the learned Montfaucon.[4]

The next discovery amongst manuscripts of this description was one of a very interesting kind. Ulphilas, bishop of Gothland in the fourth century, is known to have trans-

[1] The strict and precise sense of *Palimpsest* is "twice prepared for writing;" the repetition of such preparation being the prevailing idea in the etymology, and not erasure or obliteration, as Du Cange and others have supposed. It is indeed easy to remove from parchment, by rubbing it with pumice-stone, or some similar substance, all traces of the original writing, especially if it be of some antiquity; and if the surface be afterwards smoothed and polished, no one, by merely looking at it, would suppose that it had ever been written on. But if it be washed with an infusion of galls, and suffered to remain some time in the light, the letters obliterated will be so far restored, that they may be copied by a patient and practised decipherer, who is gifted with good vision. In those cases where the erased letters were originally written in a bold large hand,—and such are the characters of the more ancient manuscripts,—the task of deciphering them will of course be less troublesome, and the results obtained more certain. It appears, also, that the method of writing employed in ancient times has been found favourable to the restoration of works which had, to all appearance, been entirely obliterated.

[2] The *Codex Ephrem*, formerly numbered 1905, is now 9 in the *Bibliothèque du Roi*.

[3] "Fragmenta versionis Τῶν ό, a nemine adhuc (1785), quod sciamus, collata esse, mirum profecto videri debet omnibus, qui tam vetustarum membranarum excellentiam norunt." (*Symb. Crit.* i. p. 4.)

[4] *Palæographia Græca*, pp. 213, 214.

lated the whole Scriptures into the language of that country, for which he also invented a new character, consisting of letters borrowed chiefly from the Greek. This work, however, had long been lost, with the exception only of the part containing the four gospels, which is preserved in the University Library at Upsal, in a manuscript called *Codex Argenteus*, from being written chiefly in letters of silver. But in the year 1755, F. A. Knittel, having been appointed archdeacon of Wolfenbuttel, began to explore the treasures contained in the Augustan Library in that city; and, in the course of his researches, a palimpsest manuscript of the *Origines* of Isidorus was pointed out to him, as containing, under that writing, the translation of the Epistle to the Romans by Ulphilas. On examination, it proved that the manuscript in question did not contain the whole epistle, but only a portion of the latter part, viz. the eleventh and following chapters, as far as the thirteenth verse of the fifteenth, accompanied by a Latin version written in parallel columns. Knittel immediately set himself to work on this curious fragment; and although, from the state of the leaves to be deciphered, the difficulty of the task was great, yet his zeal carried him through, and towards the end of the year 1758 he announced the intended publication by subscription. Various obstacles, however, retarded its appearance till the year 1762, when the laborious decipherer was enabled to publish the whole in quarto, with twelve large plates, a circumstantial account of the manuscript, and copious illustrations of its contents.[1] The diligence of Knittel omitted nothing that could render useful the recovered fragments, of which there were several. That of Ulphilas, in particular, he carefully compared with the *Codex Argenteus*, at Upsal, and ascertained that the latter did not form part of the same, but only of a similar manuscript. From the different fragments he extracted all the various readings; and, in his ample commentary, he indulged every reasonable desire of literary curiosity. He also subjoined an account of other palimpsest manuscripts in the same library, by which it appears that printed books were, in the early times of the art, sometimes worked off on vellum from which ancient writings had been erased; and he instanced particularly an edition of the Clementine Constitutions, printed by Nicolas Janson, in 1476, upon parchment which had undergone this process of obliteration to prepare it for the purpose.

In the work of deciphering palimpsest manuscripts Knittel was followed by Paul James Bruns, the coadjutor of Dr Kennicott, in his great work of Hebrew collation. In 1773, this person discovered, at Rome, a fragment of the ninety-first book of Livy, in a rescribed manuscript of the Vatican collection; and, in the same year, it was published by the discoverer himself at Hamburg,[2] and by Signor Giovenazzi at Rome. The fragment in question, which has been admitted as undoubtedly genuine into the later editions of Livy, contains part of the war with Sertorius in Spain; and the only subject of regret is, that this part is so small. Bruns first visited the Vatican on a mission from Dr Kennicott in reference to Hebrew collation; but having been thus fortunate in the investigation of a palimpsest, he renewed the inquiry in this country, and endeavoured to ascertain the number of such manuscripts in the Bodleian Library at Oxford. An account of his researches will be found in the Literary Annals of Helmstadt, which appear to have been conducted by Bruns during the years 1782, 1783, and 1784.

But, notwithstanding these encouraging successes, no other publication of the same nature appeared until the year 1801, when Dr Barrett of Trinity College, Dublin, produced an elegant and accurate volume containing a great part of the gospel of St Matthew, copied from a rescribed manuscript in the library of that college; and this palimpsest appeared to have been re-written in the twelfth or thirteenth century, upon portions of much more ancient books. The most important of these, however, was the portion which contained the copy of St Matthew's gospel, whereof this fragment remained, written in uncial letters; and, judging by the usual marks of antiquity, it appeared to belong at least to the sixth century. A part of Isaiah in Greek, and some of the Orations of Gregory Nazianzen, were likewise found in it, but were considered as of less moment. What remains of St Matthew's gospel Dr Barrett published, with great accuracy, on sixty-four engraved plates, each representing a page of the manuscript, and containing from twenty-one to twenty-three lines, disposed in a single column. This valuable fragment commences with part of the genealogy, at verse 17, chapter i. and extends, with occasional chasms, to chapter xxvi. verse 71; and it is also represented in an equal number of pages, printed in the ordinary Greek character. Copious Prolegomena are prefixed, giving an exact account of the state and characters of the manuscript; and subjoined is a careful collation of the *Codex Montfortianus*, in the same library, with Wetstein's edition.[3] This publication, however, appeared too late to be used by Griesbach, whose second edition of the New Testament was published in the year 1796.

It remained, however, for another distinguished labourer in the new and interesting field of inquiry, which had thus been indicated rather than explored, to surpass all his predecessors and contemporaries, not only in discovering rescribed manuscripts, but also in extracting from them works or parts of works, which were long considered as irrecoverably lost. We allude, of course, to Signor Angelo Maio, formerly keeper of the Ambrosian Library at Milan, afterwards librarian of the Vatican, and now (1838) cardinal secretary; whose researches in this department have been so extensive and important, that he may truly be called the hero of palimpsests, and the discoverer of a new world of letters. It was not till the year 1814 that Monsignor Maio made himself known by the partial recovery of lost works. A year earlier, indeed, he had employed himself in translating a large portion of the oration of Isocrates, *De Permutatione*,[4] which Mystoxides, a learned Greek, had published from a manuscript in the Ambrosian Library, more perfect than any of the *codices* which had been followed by the editors of Isocrates. The quantity thus inserted in the oration increased it by at least one half; and the same additional matter has since been found in some of the Vatican manuscripts. In publishing this translation, however, Maio modestly continued anonymous. But his name was destined to be soon illustrated by far more important labours.

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[1] The manuscript of Isidorus, consisting of 330 leaves, contained portions of several older books, two of which, supposed to be of the sixth century, exhibited large fragments of the gospels in Greek. Several leaves had belonged to other works, but of these some could not be deciphered, whilst the others contained nothing to recompense the labour, excepting a fragment of the works of Galen. To these several remains, of different dates, he assigned distinctive names, classing them as separate *codices*. The fragments of the gospels he also printed entire. But the remains of the version of Ulphilas constitute the principal part of the volume, and are given with the most minute exactness. This part, however, occupied only four leaves of the manuscript of Isidorus; the other legible remains extending to 208 leaves out of the 330, so that 118 altogether defied the labour and skill of the decipherer.

[2] Saxius, *Onom.* viii. 263.

[3] This work is altogether most creditable to the industry, learning, and accuracy of the editor, Dr Barrett, and also to the University of Dublin, by which the expense of the impression was defrayed.

[4] Πεϕι τῆς ἀντιδοσιως.

1. His researches amongst palimpsest manuscripts commenced with certain hitherto unpublished fragments of three orations of Cicero, namely, those for Scaurus, Tullius, and Flaccus. These orations had been written in a quarto form, but had been partly erazed and folded into an octavo size to give place to the sacred poetry of Sedulius. The newer writing was judged to be as old as the eighth century, and the original to be not later than the second or third. The manuscript had belonged to a very ancient monastery at Bobium, or Bobbio, in the Milanese, founded by St Columban, who had also formed its library; and in the collection obtained from the same venerable institution, the greatest part of the rescribed manuscripts has been discovered. "In examining carefully some manuscripts in the Ambrosian Library at Milan," says Maio, in his preface, "I observed that one of great antiquity was a palimpsest. This manuscript had belonged to the convent of Bobbio, a monastery in Liguria, situated in the midst of the Apennines, which was founded by St Columban in the year 612, and the monks of which obtained considerable reputation for learning as well as sanctity. Gerbert, a Frenchman by birth, who became pope under the name of Silvester II., and attained so much celebrity for learning that he is one of those who are reported to have sold their souls to the devil, was head of this monastery in the tenth century, and added greatly to the reputation of the place, as well as to the contents of the library. The cardinal Frederic Boromeo, who founded the Ambrosian Library at the beginning of the seventeenth century, purchased the principal part of the collection at Bobbio, and brought it to Milan. Whilst I was examining these manuscripts," he adds, "I remarked that one, which contained some of the writings of Sedulius, a Christian poet, was a palimpsest; and on looking very closely and attentively, I discovered traces of the former writing under the latter." He then read the titles, *pro Scauro*, *pro Tullio*, and *pro Flacco*, and was able, with some trouble, to decipher the whole of the fragments of these three lost orations, written in large and very beautiful characters, each page being divided into three columns.[1] The oration for Scaurus was accompanied by *scholia*, elegantly written in small letters of a square form; and there were others in characters of a ruder form, but still ancient. These three fragments, together with the scholia (which Maio considers the production of Asconius Pedianus), were published at Milan, 1814, in one volume 8vo.

2. In the course of the same year, Monsignor Maio produced a second volume, containing various fragments of three other orations of Cicero, with some ancient annotations and commentaries never before published. The portions thus recovered belonged to the orations against Clodius and Curio, to that *De Ære alieno Milonis*, and to the oration *De Rege Ptolemæo*.[2] These treasures had lain concealed under a Latin translation of the Acts of the Council of Chalcedon, and were adjudged by the discoverer to belong to the fourth century. The palimpsest from which they were discovered had formed part of the collection obtained from Bobbio. The older writing was in very large and handsome characters, but less beautiful than that which contained the fragments of the three orations mentioned in the preceding paragraph; and there were only two columns in each page, a circumstance which seems to indicate that the writing is somewhat less ancient. The contents of these two volumes the learned editor afterwards united into one, which he published in 1817, with corrections of the fragments that had first appeared, and some additional notes and illustrations.[3] The great antiquity of the practice of rescription is sufficiently attested by these various fragments of Cicero's orations; indeed it is supposed that the speech for Scaurus was obliterated in the eighth century. But Latin manuscripts appear to have been more frequently subjected to this treatment than Greek manuscripts. The former are found to have undergone rescription at a date as remote as the seventh century; but of the latter not one has been met with in which the second writing seemed older than the eleventh century. With regard to the manuscripts from which the fragments above mentioned were recovered, Maio assures us that, in both, the ancient writing was as much superior to the modern, as the matter it contained was more precious; that, in fact, the form and the substance were both more excellent.[4]

3. The year 1815 proved very rich in discovery, and gave birth to no less than three volumes of unpublished works. One of these is peculiarly valuable and curious, as containing large portions of several orations of Symmachus, in whom, as Maio expresses it, breathed the last inspiration of Roman eloquence. The epistles of this famous orator were the only productions of his pen previously extant; but in these recovered fragments we have a copious specimen of his eloquence in two panegyrics on Valentinian, one on Gratian, a gratulation addressed to the father of the orator on his being appointed consul, and parts of several other works of the same kind, making eight in all. Maio likewise deciphered a portion of a panegyric of the younger Pliny, which was contained in the same palimpsest, but of which only the various readings are here given. The original manuscript is supposed to have belonged to the seventh or eighth century. These interesting fragments were reprinted at Frankfort in 1816, in one volume 8vo.

4. The same year another very ancient palimpsest was found in the Ambrosian Library, containing all the comedies of Plautus which have reached us, except four; and a fragment of the *Vidularia*, a lost comedy, of which all that previously remained consisted of about twenty lines, preserved by Priscian and Nonius. The ancient writing in this manuscript is exceedingly beautiful, and is supposed to be of the time of the Antonines; the more modern, consisting of part of the Old Testament in Latin, is conjectured to be of the seventh century. Maio deciphered a number of various readings, together with about sixty inedited lines belonging to the different comedies; and restored the following spirited lines of the *Stichus* (act i. sc. 5), which had previously existed in an imperfect state:

> Famem fuisse suspicor matrem mihi,
> Nam postquam natus sum, satur nunquam fui;
> Neque quisquam melius referet matri gratiam,
> Quam ego matri meæ retuli invitissimus.

This, therefore, is an important discovery, not so much on account of what has actually been recovered, as by reason of the expectations which it is calculated to encourage.

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[1] The delight of the learned librarian on making this discovery knew no bounds. "O Deus immortalis, repente clamorem sustuli, quid demum video? En Ciceronem, en lumen Romanæ facundiæ, indignissimis tenebris circumseptum! Agnosco deperditas Tullii orationes; sentio ejus eloquentiam ex his latebris divina quadam vi fluere, abundantem sonantibus verbis uberibusque sententiis." (*Præf.*)

[2] For the *first* and *third*, see the fragments of Cicero, numbered "*Orat.* 15, 16," in Ernesti's edition. But of the *second*, namely, that *De Ære alieno Milonis*, no fragment existed anterior to the discovery of Maio.

[3] This edition is entitled, "M. Tullii Ciceronis sex orationum partes, ante nostram ætatem ineditæ, cum antiquo interprete, qui videtur Asconius Pedianus, ad Tullianos septemtriones. Accedunt scholia minora vetera." Milan, 1817, 8vo.

[4] Of the more modern matter the learned editor observes, "Sed enim et illud fatendum est plerosque palimpsestos Christiana argumenta, immo ipsos divinos libros excepisse, quorum materiam, quanquam religionis gratia exosculamur, eam tamen vacuas membranas multo mallemus occupâsse."

Palimpsests.

For if Monsignor Maio found a Latin Bible containing almost an entire copy of Plautus, it cannot be affirmed that any classical author is irrecoverably lost until every Bible in manuscript, and every other writing upon ancient parchment, has been diligently examined. There is no moment at which some important discovery may not be made, provided the labour of scrutinizing parchments be persevered in. That there are many palimpsests in the public libraries of Great Britain, particularly in the Bodleian at Oxford, which is singularly rich in manuscripts, can scarcely admit of a doubt. The number of manuscripts in Spain, and her vast mass of archives, have long been equally famous; nor is it impossible that several lost works, or portions of works, by Latin authors, may yet be found in that country. Although the search for manuscripts that are directly and obviously valuable may have proved fruitless, yet a very different result may follow when parchments are examined with a view to ascertain whether a lower stratum of writing exists beneath the sterile surface, and whether some of the most precious remains of ancient genius and eloquence may not be covered or concealed by the rubbish of chroniclers and ecclesiastical writers. Great as was the destruction which took place at the Reformation,[1] enough still remains to warrant the conviction, that were there more Maios to examine and decipher palimpsest manuscripts, there would be numerous additional and most important discoveries. Who knows but that, in the most paltry and unpromising volume, may be found the works of the most eloquent of historians; that

Pellibus exiguis arctatur Livius ingens?

5. The next discovery effected by Maio, from a manuscript of the same class, was that of the remains of the orator Fronto, who had flourished in the reign of Hadrian. This writer, though by birth an African, was in his day esteemed almost a second Cicero; yet of his writings little more remained than a few scattered sentences, preserved in the works of other authors. Maio, however, by his acuteness and perseverance, was enabled to recover a very considerable portion of Fronto's works, which he published at Milan in 1815, in two vols. 8vo, under the title of *M. Cornellii Frontonis Opera inedita, cum Epistolis item ineditis Antonii Pii, M. Aurelii, L. Veri et Appiani, necnon aliorum veterum fragmentis.*[2] The contents of the first volume consist of one book of epistles addressed to Antoninus Pius, two books to Marcus Aurelius, and two to Lucius Verus; two books of letters to friends; several letters addressed to Marcus Aurelius, on the subject of the *Feriæ* at Alsium, a town in Etruria; and one to Lucius Verus, in which the orator laments the death of his grandson, one of the children of his son-in-law Victorinus. The second volume exhibits a considerable portion of two books, *De Orationibus*, addressed by Fronto to Marcus Aurelius; parts of various orations and epistles; and also a portion of an address to Antoninus, entitled *De Bello Parthico*, consoling him for the reverses experienced in the Parthian war. Then follow some important fragments under the title of *Principia Historiæ;* a few playful prolusions on lighter subjects; and a book of epistles written in Greek. The work is concluded with a collection of all the fragments of Fronto's works which have elsewhere been preserved, and with copious illustrations of those which were then for the first time published. In the palimpsest from which these curious remains were deciphered, the more recent writing formed part of the Council of Chalcedon; but the manuscript was unhappily much damaged, and altogether in a very imperfect state. Fronto was a voluminous writer, and composed works upon various subjects, amongst which was an Invective against the Christians. He had a great reputation as an orator, and was accounted the Cicero of his time; although his style, which is said to have united the *siccum* and the *grave*, does not very well accord with such a distinction. The writings of so remarkable a person, however, would, in any circumstances, be an object of interest; but they become doubly curious from having been thus marvellously brought to light.

6. In the mean time, Maio was preparing another publication of similar origin, which, in 1816, he gave to the world, under the following title, viz. *Interpretes Veteres Virgilii Maronis; Asper, Cornutus, Haterianus, Longus, Nisus, Probus, Scaurus, Sulpicius, et anonymus; e Veronensi palimpsesto.* We have not met with any account of the Verona palimpsest here mentioned; but the work consists of previously inedited fragments of all the commentators enumerated in the title. A palimpsest manuscript, however, which soon afterwards engaged the attention of Monsignor Maio, enabled him to make most important additions to the discovery of Knittel already described; namely, that of the Gothic version of Ulphilas. This manuscript belonged to the Ambrosian collection, and from it Maio published, in 1820, *Ulphilæ Interpretatio Gothica, in Ambrosiano palimpsesto detecta, epistolarum tredecim Divi Pauli, aliarumque partium aliquot Biblicarum, Esdræ nimirum, Nehemiæ, Divi Matthiæ, cum anonymi Homilia, seu Tractatu, et cum parte Gothici calendarii.* Not having seen this work, however, we are unable to give any particular account of it, or to specify the various important additions which it is understood to have made to the discovery of Knittel.

7. Maio now entered upon a more enlarged and important scene of action. His distinguished merit in this new field of discovery having obtained for him the notice of Pius VII., he was, by that pontiff, appointed keeper of the Vatican Library, and speedily justified this preferment by a discovery more interesting and valuable than any which he had hitherto made. In a palimpsest volume, which had formed part of the manuscript collection originally brought from Bobbio,[3] and which contained, in the exterior writing, part of the commentary of St Augustin on the Psalms, he found

[1] In the Protestant parts of Europe the most frightful havoc was committed at the Reformation. Huge volumes containing the ancient services abounded in all the churches and monasteries. Most of these had been brought directly from Rome; and in the days when books of this kind were transcribed, it must have been considered as an act of piety to erase almost any writing whatever, to make way for the sacred offices. From the very nature of these books, indeed, there can be little doubt that much *ancient* parchment entered into their formation; and as they were carefully preserved, exempt from accident or injury, there can be little doubt that in many, perhaps in most of them, there existed under the rescription the remains of more ancient writings. Yet, wherever they could be found, they were consigned to the flames without mercy, in virtue of enactments which enjoined the destruction of all popish books; and inestimable chances of discovery were thus for ever lost to the world.

[2] This work, like a former one, was reprinted at Frankfort, in the year 1816.

[3] The history of the manuscript which contained these precious remains may be very shortly stated. It originally belonged to the famous monastery at *Bobium*, and was purchased by Paul V. more than two centuries ago, with the knowledge that it was a palimpsest, and contained part of Cicero's treatise *De Republica;* though, by some strange neglect, it was reserved for Maio to bring its contents to light. From the same original library most of the other manuscripts at Milan and Turin were also purchased. This library, as well as the monastery, was founded by the famous Irish saint, Columbanus, in the beginning of the seventh century; and most of the manuscripts, from which remains of ancient authors have been recovered, are inscribed, in a very old handwriting, *Liber Sancti Columbani de Bobio.*

that the interior or more ancient writing had consisted of the long-lost books of Cicero *De Republica*, the most celebrated of all his works, and of which nothing had been known, in modern times, beyond the fragments preserved in the writings of Macrobius, Lactantius, Augustin, Nonius, and others. The manuscript was in excellent order; the characters were large and plain; and, in the leaves which remained, there was scarcely a page that could not be deciphered; but many of the pages were wanting. And there seemed reason to apprehend that the same deficiency would often occur in future discoveries, because the work last inscribed might not have been co-extensive with the original writing obliterated, and because, when the volume had been taken to pieces for the purpose of rescription, the whole of the leaves that contained the original writing might not have been put together again, but some of them applied to other purposes, and leaves taken from other works, or of new parchment, inserted in their place. But however this may be, in these invaluable pages a very considerable part of the first and second books of the celebrated treatise in question was found so perfect as to be completely recovered by the labour and sagacity of Monsignor Maio. The portions of the work thus rescued from oblivion were published at Rome in 1821,[1] with copious notes and illustrations, particularly an accurate account of the various chasms occasioned by the loss of original leaves, and accompanied with such a restoration of the four remaining books as could be effected from the less perfect portions of the manuscript, and the various fragments preserved by Sigonius and other critics. A finer specimen of editorial skill, learning, and sagacity, is nowhere to be found.

The part of this important treatise which has thus been unexpectedly brought to light, is amply sufficient to give a clear insight into the plan and style of the dialogues, as well as into the characters of the various interlocutors, under whose names the illustrious author chose to develope his own opinions. These were, the second Scipio Africanus, and his friend Lælius; L. Furius Philus; M. Manilius, whom Cicero elsewhere praises for his knowledge of the law; Sp. Mummius, the brother of Mummius Achaicus; Q. Ælius Tubero; P. Rutilius Rufus; Q. Mucius Scævola; and C. Fannius, son-in-law of Lælius. The introduction to the first book is nearly complete; but that which stamps the highest value on the work is the luminous philosophy of the author on the subject of government and policy, as expounded by Scipio, the principal interlocutor, with unrivalled eloquence and felicity of expression. We now understand the grounds upon which the ancients preferred this to all Cicero's philosophical works; and, on the whole, notwithstanding its still imperfect state, it is unquestionably one of the most interesting acquisitions that have been made, in the department of classical literature, since the original publication of the ancient authors, soon after the revival of letters. May we not indulge the hope that, ere long, some important additions will be made to the invaluable fragment which Maio has so laboriously and skilfully brought to light?[2]

8. The zeal and the industry of Maio did not relax from success. On the contrary, soon after the appearance of the fragment of Cicero's treatise *De Republica*, he gave to the learned world another elaborate publication, containing, 1. Juris Civilis Antejustinianei Reliquia inedita; 2. Symmachi Orationum partes; 3. C. Julii Victoris Ars Rhetorica; and, 4. L. Cæcilii Minutiani Apulei Fragmenta de Orthographia. These remains were also recovered from a rescribed manuscript in the Vatican Library, and were, as usual, accompanied by notes, appendices, and illustrative plates. In the preface to this work, the learned editor expresses his unabated enthusiasm in exploring and deciphering the palimpsest manuscripts of the Vatican collection: "Pergo alacriter," says he, "rescriptos Vaticanæ Bibliothecæ codices, pro meæ stationis munere, ad publicum commodum explicare." The praises due to his alacrity, as well as to his sagacity and perseverance, will not certainly be denied, nor even grudgingly awarded, by those who are capable of appreciating the full extent and importance of his long-continued labours in this interesting department of literary investigation.[3]

The example of this extraordinary success could scarcely fail to excite the curiosity and stimulate the diligence of the learned; and, accordingly, another labourer of high qualifications soon entered the same field of inquiry. The library of the Chapter of Verona had long been famous for the number of the manuscripts contained in it; and it was also known to be remarkably rich in those which related to jurisprudence. In the *Verona Illustrata* of Maffei, published in 1732, the author had given an index to all the manuscripts, and particularly mentioned several leaves of parchment, some of which treated of Prescriptions and Interdicts, whilst others contained fragments of the Pandects, and part of the work of an ancient jurisconsult; "quai codici, se si fossero conservati, niente si ha in tal genere, che lor si potesse paragonare." The leaves in question were afterwards bound up in a small volume, composed of fragments of different manuscripts; and extracts from both were published by Maffei, with a fac-simile of the characters, in his *Istoria Teologica*. But these curious relics attracted little attention, or rather were altogether forgotten, until the successful researches of Maio had awakened and animated the curiosity of the learned. In the year 1816, however, Haubold revived the recollection of them by printing at Leipzig a treatise entitled *Notitia Fragmenti Veronensis de Interdictis*; which appears to have attracted considerable notice. In the same year, Niebuhr, passing through Verona on his way to Rome, as Prussian envoy to the court of the Vatican, visited the library of the Chapter, and, during two days which he passed at Verona,

[1] The work, as stated in the text, was published at Rome, with a grateful dedication to Pius VII. to whom Maio had been indebted, not only for his preferment, but also for numerous other acts of kindness and favour. It was also republished at London, 1823, in one vol. 8vo.

[2] In proof of the great antiquity of the practice of obliterating one writing to make room for another, Maio, in the learned preface to his edition of the dialogue *De Republica*, cites part of a letter from Cicero to Trebatius, which is conclusive on the point. "Ut ad epistolas tuas redeam, cætera belle....nam quod in Palimpsesto, laudo equidem parsimoniam; sed miror quid in illa chartula fuerit quod delere malueris quam hæc non scribere, nisi forte tuas formulas. Non enim puto te meas epistolas delere, ut reponas tuas. An hoc significas, nihil fieri? frigere te? Ne chartam quidem tibi suppeditare?" (*Ad Familiares*, vii. 18.) The learned editor further informs us, that he had only met with palimpsest *parchment*, and that *paper* of every kind seemed to be unfit for such a purpose.

[3] To do full justice to the merits of Monsignor Maio, it would be necessary to expatiate upon several learned and elaborate works, which, within the same period, his unexampled industry produced, from very different sources. As specimens of these, we shall mention only two, viz. 1. The splendid folio volume of fragments of the Iliad, with ancient illustrations, elegantly copied in outline, and unpublished scholia on the Odyssey, from a most valuable manuscript in the Ambrosian Library; to which are prefixed large and important *prolegomena*: and, 2. The Latin edition of the Chronological Canons of Eusebius, in two books, the first of which had been wholly lost to the western world, until it was recovered by Maio from an Armenian manuscript. In the latter work the editor had the valuable assistance of Dr Zohrab, a very learned Armenian. These and other works, a list of which will be found at the end of his Homer, may serve to show that, difficult and laborious as the task of deciphering palimpsest manuscripts may appear, it does not so exhaust the energies of an active mind, as to prevent the successful pursuit of other learned inquiries and researches.

Palimpsests.

took an accurate copy of the fragment *De Præscriptionibus et Interdictis*, and also transcribed another, *De Jure Fisci*. But if this had been all, the labours of these two days, however meritorious, would perhaps have soon been forgotten. Fortunately for letters, however, he examined another manuscript, then numbered xiii., and found that the exterior writing contained some epistles of St Jerome, whilst a more ancient writing appeared underneath. On further examination Niebuhr perceived that the latter contained the work of some ancient jurisconsult; and having applied the infusion of galls to folio 97, he so far restored the characters as to be able to transcribe the portion of the original text therein contained. He then communicated his discovery to Savigny, and, with the assistance of the latter, published, in a periodical work, the specimen transcribed, accompanied with an ingenious commentary, in which he maintained that the manuscript referred to contained the Institutions of Gaius, and that the fragment *De Præscriptionibus et Interdictis* formed part of that work.

The result fully established the soundness of this conclusion. Two other labourers were therefore sent by the Berlin Academy of Sciences to work the mine which Niebuhr had thus happily opened; and having obtained the permission of the Chapter, they transcribed the manuscript almost entirely, only about one ninth part of the whole, or rather less, being found illegible. The transcript was immediately submitted to the academy, and the Institutions of Gaius first appeared at Berlin in the year 1820.[1] The manuscript from which this invaluable relic of ancient jurisprudence was recovered consists of 127 leaves. The more recent writing, which is in uncial characters, and of considerable antiquity, contains some of the works of St Jerome, chiefly his epistles, of which there are twenty-six. The more ancient is of two kinds; the one remarkable for its antiquity and elegance, and the other intermediate, that is, written *over* the first, and *under* the third or last writing The former of these is that in which the Institutions of Gaius were written; so that the intermediate kind had superseded the work of the Roman jurisconsult, but had, in its turn, yielded to the third and last writing. As to the age of the original manuscript, Niebuhr very early expressed an opinion that it was older than the time of Justinian; and Kopp, judging from the forms of the letters, the contractions, and various other indications, arrived at the same conclusion. It is creditable to the literary curiosity of Germany that the first edition of this work was almost immediately sold off. Bluhm, who had been concerned in the first transcription, paid another visit to Verona, where he re-examined the manuscript with great care; and the fruits of his labour appeared in the second edition, which was published in 1824. In the following year, a third edition appeared at Leipzig, without the notes of Goeschen, and with the modern instead of the ancient orthography, which had been religiously retained in the two Berlin editions. Gaius was somewhat late in attracting attention in France, where learned lawyers were once so abundant; but the translation of M. Boulet had the effect of partially awakening the curiosity of his countrymen, by rendering this invaluable relic of Roman jurisprudence more easily and generally accessible.[2]

The history of such extraordinary successes in deciphering palimpsest manuscripts ought surely to excite the emulation of scholars in other parts of Europe, where large collections are deposited, and lead them to examine whether, in many of these, similar materials may not be found. Knittel aptly denominates his rescript of various contents another Herculanum; and, in fact, more of importance has already been recovered from this class of manuscripts than from all the half-consumed volumes obtained from that once promising repository. Every information that may be wanted as to the true mode of examining and deciphering such manuscripts, will be found in the learned prefaces of Knittel, Barrett, and Maio; with much to encourage scholars to engage in the same pursuit, unless perchance their ardour be cooled by the prospect of the severe and unremitting labour which is indispensably necessary to ensure success. It should also be remembered, that the Latins commenced the practice of rescription as early as the sixth or seventh century, and continued it not only till the invention of printing, but even after that period; and that, making every allowance for the destruction which took place at the Reformation, the number of palimpsests still in existence must, beyond all question, be very great. All that is wanted, therefore, to ensure further acquisitions, is labour and research, united with patience and ordinary sagacity. By what has already been achieved, we are, so to speak, placed upon a vast plain, which has no defined limits; and although the horizon may seem to our senses to circumscribe the prospect, yet, on whichever side we advance, the apparent obstacles vanish, and our view still continues as extensive as before. (A.)

Palingenesia. Palinurus.

PALINDROMUS, a verse or sentence which runs the same when read either backwards or forwards. Such is the verse,

Roma tibi subito motibus ibit amor.

Some people of leisure have refined upon the palindromus, and composed verses, each word of which is the same read backwards as forwards; for instance, that of Camden:

Odo tenet mulum, madidam mappam tenet Anna.
Anna tenet mappam madidam, mulum tenet Odo.

PALINGENESIA, amongst divines, the same with regeneration. Amongst the older chemists, it denotes the producing of a body from its principles.

PALINGENIUS, MARCELLUS, an Italian poet, well known by a poem divided into twelve books, and entitled *Zodiacus Vitæ*, which occupied him several years in composing, and dedicated to Hercules II. of Este, duke of Ferrara. Some say he was a physician to that prince; others rank him amongst the learned Lutherans, to whom the Duchess of Ferrara gave a reception in her court, and honoured with her protection. His Zodiac contains good things, and is a philosophical satire against immorality and false prejudices. Of the author's life, however, little is known. He died some time between the years 1537 and 1543.

PALINODE, a discourse contrary to principles formerly avowed; and thence the phrase of *palinodiam canere* means a recantation.

PALINURUS, in fabulous history, the pilot of Æneas, whose fate Virgil very pathetically describes. He fell into

[1] Gaii Institutionum Commentarii iv. e codice rescripto Bibliothecæ Capitularis Veronensis, a Frid. Bluhmio iterum collato secundum edit. J. F. L. Goeschen. Accedit Fragmentum veteris Jurisconsulti de Jure Fisci, ex aliis ejusdem Bibliothecæ membranis transcriptum. Berolini, 1824, 8vo. We have not met with the less perfect edition of 1820.

[2] Who was Gaius, and when did he flourish? This is a question which it has been found exceedingly difficult to answer. From a number of circumstances, however, it has been conjectured that he was born under Hadrian, that he began to write about the end of the reign of Antoninus Pius, that he attained the summit of his celebrity under M. Aurelius, and probably died under Commodus. "Scripsit autem ille, *quisquis fuerit*, Institutiones," says Gravina, "unde suas magnam in partem depromsit Justinianus;" and Justinian himself, in speaking of his own Institutions, thus acknowledges his obligations to Gaius: "Quas, ex omnibus antiquarum institutionibus, *et præcipue ex Commentariis Gaii nostri*, compositus," &c.

the sea when asleep, and was three days exposed to the tempests, but at last got safe ashore, when the cruel inhabitants of the place murdered him to get his clothes. His body was left unburied on the sea-shore; and since no one could cross the Stygian lake before a hundred years were elapsed, if his remains had not been decently interred, we find Æneas, when he had descended to the regions below, speaking to Palinurus, and assuring him, that though his bones were deprived of sepulture, yet the place where his body was exposed should soon be adorned with a monument, and bear his name; and accordingly a promontory was called *Palinurus.*

PALISSE, La, an arrondissement of the department of the Allier, in France, extending over 638 square miles. It comprehends six cantons, divided into seventy-seven communes, and contains 65,200 inhabitants. The capital is the city of the same name, situated in a fertile spot on the left bank of the river Allier. It contains 2250 inhabitants, who are employed in spinning cotton, and to a considerable extent in making boots and shoes.

PALKAH, a small town of the Sikh territories, in the province of Lahore, 112 miles north-east from the city of Lahore. Long. 75. 13. E. Lat. 32. 58. N.

PALK'S Straits, an arm of the sea, which separates Ceylon from the coast of Coromandel.

PALL, in *Heraldry*, a figure like a Greek γ, and about the breadth of a pallet. It is by some heralds called a *cross pall*, on account of its being looked upon as an archiepiscopal bearing.

PALLA, in Roman antiquity, a mantle which women wore over the gown called *stola.* It was borne on the left shoulder, whence passing to the other side, under the right arm, the two ends were bound under the left arm, leaving the breast and the arm quite bare. It had a great many folds, and derived its name from παλλω, *to shake* or *tremble.*

Palla *Isle*, a small island in the Eastern Seas, about six miles in circumference, situated to the south of Sangir. Long. 125. 30. E. Lat. 3. 5. N.

PALLADIO, Andrea, a celebrated Italian architect, was born at Vicenza in 1518, being descended of a family originally of Friuli. The celebrated Trissino was his friend and Mæcenas. He made exact drawings of the principal works of antiquity in Rome, adding commentaries, which went through several impressions. But this, though a very useful work, was greatly exceeded by his Treatise of Architecture, in four books, which appeared in the year 1570. On this work Inigo Jones wrote some excellent remarks, which were included in an edition of Palladio, published by Leoni in 1741, in two vols. folio. Palladio died at Vicenza, on the 19th of August 1580, in the sixty-second year of his age.

PALLADIUM, in *Antiquity*, a statue of the goddess Pallas, or Minerva. It was about three cubits high, and represented the goddess sitting, with a pike in her right hand, and in her left a distaff and a spindle. However various the opinions of ancient authors be about this celebrated statue, it is universally allowed that on its preservation depended the safety of Troy. This the Greeks, during the Trojan war, were well aware of; and therefore Ulysses and Diomedes were commissioned to steal it. They effected their object; and if we may rely upon the authority of some, they were directed how to carry it away by Helenus, a son of Priam, who in this betrayed his country, because his brother Deiphobus, on the death of Paris, had married Helen, of whom he was enamoured. Minerva was enraged at the violence offered to her statue. According to Virgil, the palladium itself seemed to have received life and motion; and by the flashes which darted from its eyes, and its sudden springs from the earth, it seemed to evince the resentment of the goddess. According to some, however, the true palladium was not carried away from Troy by the Greeks, but only a statue of similar size and shape, which was placed near it, to deceive any sacrilegious persons who might attempt to steal it. They maintain, therefore, that Æneas conveyed the palladium safely from Troy to Italy; and that it was afterwards preserved by the Romans, with the greatest secrecy and veneration, in the temple of Vesta, a circumstance which none but the vestal virgins knew of. It was esteemed the destiny of Rome; and there were several others made perfectly like it, to secure it from being stolen, like that of Troy, which the oracle of Apollo declared would never be taken as long as the palladium was found within its walls. A palladium was also placed by Nicias in the citadel of Athens.

PALLADIUS, bishop of Helenopolis in Bithynia, and next of Aspona. He was a Galatian, and born at Cappadocia. He became an anchorite in the mountain of Nebria in 388, and was consecrated bishop in 401. He was an intimate friend of St John Chrysostom, whom he never forsook during the time of his persecution, nor even in his exile. He went to Rome some time after Chrysostom's death, and, at the request of Lausus, governor of Cappadocia, composed a history of the anchorites or hermits, which he entitled *Lausiaca*, after the name of Lausus, to whom it was dedicated. This took place in the year 420, when the book was written; the author being then in the twentieth year of his episcopacy, and fifty-third of his age. Palladius was accused of being an Origenist. It is true, he was an enemy to St Jerome, of whom he does not speak well, and was intimately connected with Ruffinus; but perhaps no good proof can be brought of his Origenism. He had been the disciple of Evagrias of Pontus, and was even suspected of entertaining the sentiments of Pelagius. He died in the fifth century, but in what year is not certain. His history was published in Greek by Meursius, at Amsterdam, in 1619, and in Latin in the *Bibliotheca Patrum;* but he seems not to have been the writer of the Life of St John Chrysostom in Greek and Latin, printed in 1680.

PALLANZA, a province of the principality of Piemont, in the continental part of the kingdom of Sardinia. It is bounded on the north by Domo d'Ossola, on the east by Lago Maggiore, on the south by Novara, and on the west by Val di Sesia. It extends over 506 square miles, contains 135 towns and villages, fifty-six hamlets, and 115,000 inhabitants. It is in the north mountainous, in the south undulating, but very generally picturesque, especially on the eastern side, near the Lake Maggiore, which is adorned with the Borromean Islands. It is productive of fruit, tobacco, chestnuts, and wine; but does not grow quite sufficient corn for the consumption of its dense population, who are frequently compelled to wander to other districts to seek employment and subsistence. The capital is the small city of the same name situated on a point of land running into Lago Maggiore, on which it has a harbour for small craft. It contains two churches, a nunnery, a public school, and 1320 inhabitants.

PALLAS, Simon Peter, a distinguished naturalist and geographer, born on the 22d of September 1741, was the son of Simon Pallas, a surgeon in the Prussian army, and professor of surgery at Berlin.

He received the early part of his education in his father's house, and his instructors bore ample testimony to the rapidity of his progress. At the age of fifteen he began to attend medical lectures, and he applied himself so closely to practical anatomy, that in 1758 he was found qualified to deliver a course of public lectures on that science. In the same year he went to Halle, and became the pupil of Segner, continuing also his studies of zoology, and, in particular, of entomology, with great assiduity. In

Pallas.

1759 he removed to Göttingen, where he made a variety of experiments on poisons, and on other active medical substances, and commenced his observations on parasitical animals. In July 1760, he went on to Leyden, in order to attend the lectures of Albinus, Gaubius, and Muschenbroeck; and at the end of the same year he took his degree of doctor of physic. The following summer he proceeded to England, principally with the view of completing his medical education, although he devoted the greater part of his time to the active pursuit of natural history, being assisted and encouraged by the friendship of Peter Collinson, and of some other British naturalists, which procured for him a few years afterwards the distinction of having his name inserted in the list of the foreign members of the Royal Society, at the early age of twenty-three. He visited several parts of the coast of England, in order to examine its marine productions; and his love of natural history enabled him to profit in a similar manner by an accident which detained him for some time at Harwich, on his return to the Continent, in the spring of 1762.

Having paid a visit to his native city, he went again to the Hague, and established himself as a resident there under the patronage of Gaubius. On occasion of the publication of a miscellaneous work on zoology, which he dedicated to the Prince of Orange, he proposed a plan for an expedition to the Cape of Good Hope, and to the Dutch East Indies, which he offered to conduct in person; but although the project was encouraged by Gaubius, and approved by the prince, his father's interference prevented its execution, and obliged him to return to Berlin. His filial affection, however, was not strong enough to induce him to refuse the invitation of the Empress Catharine to St Petersburg, where he accepted, in the year 1767, the appointment of professor of natural history in the Imperial Academy of Sciences.

The first few months of his residence at St Petersburg were employed in preparing his Zoological Gleanings for publication, and in making catalogues of some collections of natural history. It was now that the more active career of his public life was about to commence; and in 1768 he undertook, in common with Falk, Lepechin, and Guldenstädt, the conduct of an expedition sent out by the empress, for the joint purposes of observing the transit of Venus, and of investigating the natural history and geography of Siberia, and the neighbouring countries. The object of their researches for the first summer was the province of Kasan, and the winter was passed at Simbirsk: the next year they examined the shores of the Caspian, and the borders of Calmuck Tartary; after which they returned through Orenburg, and passed the winter at Ufa. In 1770 Pallas crossed the Uralian Mountains to Catharinenburg, and, after examining the mines in that neighbourhood, proceeded to Tobolsk. The next year he went to the Altaic Mountains, traced the course of the Irtysch to Kolyvan, went on to Tomsk, and observed the natural freezing of quicksilver at Krasnoyarsk, on the Yenisei, in latitude 56½° north. He proceeded in March 1772 by Irkutsk across the Lake Baikal, as far as Kiatka, and returned to Krasnoyarsk. In 1773 he visited Tara, Astracan, and Tzaritzin, on the Volga, and returned to St Petersburg in 1774, after an absence of six years. About ten years later he was made a member of the Board of Mines, with an additional salary of L.200 a year; and he was complimented with the title of a knight of St Vladimir. The empress purchased his collection of natural history for a price one third greater than his demand, and allowed him, at the same time, to keep it in his possession for the remainder of his life.

In 1794 he took a journey into the Crimea, and was captivated with the beauty of the country and its productions; the climate also appearing to be such as his health was supposed to require, he obtained from his munificent patroness not only permission to establish himself there, but a grant of a large and fertile estate, and a sum of 10,000 rubles to assist him in his outfit. He was thus enabled to build a little palace rather than a country house, in which a traveller from the north of Europe was sure to receive the most obliging hospitality, as Dr Clarke has made well known to the English reader. It appears, however, that the air was not altogether exempt from the miasmata, which are the causes of paludal fevers; and some other circumstances, besides the distance from all civilized society, seem to have made the old age of Pallas more cheerless than he had anticipated to find it, in the independence and tranquillity of his patriarchal establishment at Akmetshet. About ten years after the period of Dr Clarke's travels, he undertook a journey to Berlin to pay a visit to his brother, and died there in September 1811.

Linné the younger has given him a genus, *Pallasia*, in his *Supplementum Plantarum;* a compliment to which his unremitting labours, in every department of natural history, had amply entitled him. His collection of dried plants was purchased by Dr Clarke's fellow-traveller, Mr Cripps, and passed into the possession of Aylmer Bourke Lambert.

The general character of Professor Pallas's acquirements appear to have been that of extent and variety, together with fidelity. He was not the author of any new theories or improved systems; and it has sometimes been observed, as by Murray in his System of Vegetables, that his descriptions were somewhat defective, from the omission of correct specific distinctions; but this omission is of such a nature as to affect a compiler or a book-maker much more than an actual student of natural history who is studying for his own improvement only, and who is capable of entering into a detailed examination of the objects concerned. To such a detail the principal part of Professor Pallas's works have relation; and it is impossible to enumerate the whole of his memoirs without making a pretty extensive catalogue of the productions of the various kingdoms of nature.

1. His Dissertatio Inauguralis de Insectis Viventibus intra Viventia, 4. Leyden, 1760, containing a systematic account of intestinal worms, is said to have been previously published in another form at Göttingen, a short time before he went to Leyden. 2. We find in the Philosophical Transactions for 1763, p. 62, a short note On the Cold observed at Berlin the preceding winter. 3. In the volume for 1766, p. 186, a description of the jaculator fish, or Sciæna jaculatrix of the Indian Ocean, which catches insects by darting drops of water at them: this description is repeated in the *Spicilegia Zoologica*, fasc. 8. 4. Elenchus Zoophytorum, 8. Hague, 1766; containing nearly three hundred species; Dutch by Boddaert, with figures, 8. Utrecht, 1768. 5. Miscellanea Zoologica, 4. Hague, 1766; consisting of descriptions and dissections. 6. Spicilegia Zoologica, 4. Berl. 1767–1780. Of this valuable collection of memoirs, intended for the description and illustration of new or little-known species of animals, there appeared in the whole fourteen fasciculi; some of them were published by Professor Martin during the author's absence in Siberia. We find, amongst other articles, an interesting account of the musk-deer, of various species of the antelope, and on the different varieties of sheep, both wild and tame; the latter has been published in English, On Russian and Tartar Sheep, 8. Edinb. 1794. 7. In the *N. Act. Acad. Nat. Cur.* iii. p. 430, Phalænarum biga; an account of two species of moth, of which the females are without wings, and spontaneously fertile. 8. A variety of miscellaneous papers, by Pallas, appeared in the Stralsund Magazine, which began to be published at Berlin in 1767: they

Pallas. chiefly relate to the Winter Residence of Swallows, vol. i. p. 20; to Hydatids found in the abdomen of ruminant animals, and supposed to be a species of tænia, p. 64; to the Birds of Passage of Siberia, p. 145, from Heller's Notes; to Firmin's supposed discovery of the Origin of the Belemnite, p. 192; to some Peculiarities of Insects, p. 225; to a Poison supposed to be prepared in Siberia from the Sitta, or nut-hatch, p. 311; to the Elk or Moose-Deer, p. 382, from Heller's papers; and to the use of the Sphondylium in Kamtschatka, p. 411. 9. Collections relating to the Mongol Tribes, published in 1776, and showing that they are distinct from the Tartars.

10. Professor Pallas's contributions to the Memoirs of the Imperial Academy of St Petersburg are also very numerous, and on miscellaneous subjects. In the *Novi Commentarii* we find an account of the Tubularia Fungosa, vol. xii., observed near Wolodimer; Lepus pusillus, and Fossil Bones of Siberia, vol. xiii.; Quadrupeds and Birds observed in 1769, vol. xiv. 1; Remains of Exotic Animals in Northern Asia, vol. xviii., especially the skulls of the rhinoceros and the buffalo; Tetrao arenaria, Equus hemionus, and Lacerta apoda, vol. xix.; the last also in Geneesk. Jaerboek, ii. In the *Acta* for 1777, ii., An Account of the Teeth of an Unknown Animal, like those which have been found in Canada; Observations, from Camper's Letters, on a Myrmecophaga and a Didelphis, and Equus asinus in the wild state. In the volume for 1779, ii., a Description of Plants peculiar to Siberia; Capra Caucasica, also in Lichtenberg's *Magazin*, ii. For 1780, part i. Galeopithecus vitans; part ii. On the Variations of Animals, and Didelphis brachyura. For 1781, part i., Felis manul, a new Asiatic species of Felis; ii., On some Species of Sorex. In the volume for 1783, New Species of Fishes; and 1784, On some new Marine Productions.

11. The Observations sur la Formation des Montagnes, et les Changemens arrivés au Globe, particulièrement à l'égard de l'Empire Russe, published separately, 4. Petersb. 1777, were also inserted in the *Acta* of the Academy for 1777, having been read at a public sitting before the king of Sweden. A translation of this discourse is inserted in Tooke's Russian Empire, and some remarks on it are found in the *Journal de Physique*, vol. xiii.

12. The most considerable of the separate publications of Pallas was the account of his travels, entitled Reise durch verschiedene provinzen des Russischen Reichs, 3 vols. 4. Petersburg, 1771–3–6; French, 8vo, 8. Par. 1803; English, 2 vols. 4. London, 1812; a work of the highest authority in geography and natural history. 13. It was in the course of these travels that Pallas observed in Siberia an insulated mass of native iron, which he described in a paper addressed to the Royal Society of London, and printed in the Philosophical Transactions for 1776, p. 523; a substance which has become the subject of many discussions, from its resemblance to some of the specimens of well-ascertained aërolites; the author mentions also the remains of an unmineralized rhinoceros, which had been found in the same country.

14. In the *Beschäftigungen Naturforschenden Freunden*, published at Berlin about 1777, we find a letter on the Acipenser ruthenus, or sturgeon, vol. ii. p. 532; and An Account of a Monstrous Horse, vol. iii. p. 226. 15. Some Mineralogical Observations, addressed to Born, are published in the *Böhmische Abhandlungen*, vol. iii. p. 191. 16. In the Swedish *Handlingar* for 1778, we have the Alauda Mongolica, and the Sturnus Daauricus; the Anas glocitans, in 1779.

17. Novæ species Glirium, 4. Erlang. 1778. 18. Icones, Insectorum, præsertim Rossiæ Sibiriæque, 4. Erlang. 1781. 19. Enumeratio Plantarum Procopii a Demidoff, 8. Petersb. 1781.

20. Another channel in which a number of Pallas's most valuable essays appeared, is the work entitled *Neue Nordische Beyträge*, which he published at St Petersburg and Leipzig in 1781 and the following years. The most remarkable of the subjects of these are, A great Exotic Animal found in Kasan in the year 1776; on the Migration of the Water-Rat on the Volga, and Observations on Tæniæ, vol. i.; further Remarks on Tæniæ; on American Monkeys bred at St Petersburg; on the Ardea helias; on the Culex lanio, sometimes fatal to Cattle; on the Phalangium, or Scorpion Spider; and on Copper Island, in the Sea of Kamtschatka, vol. ii.: on Two Birds; and on the Labrador Stone, vol. iii.: on a Cross of the Black Wolf with the Dog; on a Mine; on the Oriental Turquois; and Mineralogical Novelties from Siberia, vol. v.

21. In the *Physische Arbeiten* of Vienna, we have a geological Essay on the Orography of Siberia, vol. i. 1.

22. Flora Rossica, f. vol. i. Petersb. 1784; ii. 1788, published at the expense of the empress.

23. Tableau Physique et Topographique de la Tauride, 4. Petersb. 1795; German, in *N. N. Beyträge*, vii.: a work derived chiefly from the observations made by the author in his travels of 1792.

24. A Monography of the Astragali is mentioned by some of his biographers.

25. He edited also Guldenstädt's *Reisen durch Russland und in den Caucasischen gebirgen*, ii. v. 4. Petersb. 1787–1791. 26. He also compiled and arranged the two first and most valuable of the four volumes of the Vocabularia Comparativa, 4. Petersb. 1787, in which he attempted to make some improvements in the Russian orthography.

(Coxe's *Travels*; Clarke's *Travels*; Tooke's *Russian Empire*; Halleri *Bibliotheca Anatomica*; Aikin's *General Biography*, vol. x. 4to, Lond. 1815; Chalmers's *Biographical Dictionary*, vol. xxiii. 8vo, Lond. 1815; Dryander, *Bibliotheca Banskiana*.) (L. L.)

Pallavicini. PALLAVICINI FERRANTE, a noted Italian writer, descended from a noble family in Piacenza, was born about the close of the sixteenth century. He soon gave proofs of an extraordinary genius, and improved rapidly in classical erudition. He was afterwards sent to complete his education in the monastery of Augustinian friars at Milan, where he took the habit, lived much esteemed for piety and learning, and raised great expectations of future fame; but being somewhat amorously inclined, he engaged in an intrigue with a young woman of Venice, whose charms proved irresistible; and in order to enjoy them without restraint, he obtained leave from his general to make the tour of France. Accordingly he pretended to set out for that country; but it was only a blind to cover his real design. He never left Venice, where he lived privately, enchanted with the attractions of his Venus; and having too ready a talent for invention, he imposed upon his friends, by often sending them, in letters, feigned accounts of his travels through France, and also informing them of several things respecting that court, which he learned from the advices of many considerable persons with whom he corresponded.

His finances were in the mean time greatly reduced; and in this exigency he naturally had recourse to his wits for supplies. He wrote for the booksellers, and composed several pieces, more for the sake of gain than out of any fondness for authorship. Amongst other things, he wrote a collection of letters, mostly satirical, which he called The Courier Robbed of his Mail. The work appeared at first in such a cast as could not give great offence, except to the Spaniards, against whom he had some grudge, and the piece was accordingly licensed by the inquisitors; but when it fell into the hands of the secre-

Pallavicini.

tary of the republic of Venice, who was at that time licenser of books, he refused his *imprimatur*, though great interest was employed for that purpose; neither would he return the manuscript. This enraged Pallavicini so much, that had not his friends restrained him, he would have pursued the affair to his ruin.

At length he found an opportunity of travelling into Germany with the Duke of Amalfi, as his grace's chaplain. But this journey had no good effect either on his wit or his morals. On the contrary, finding himself, from the manners of the Germans, more at liberty, he indulged his genius and passions with greater freedom; and after a residence of more than a year in that country with the duke, he returned to Venice. He was now resolved to have his full measure of revenge against the secretary of the republic for keeping back his manuscript, and also to attack the family of Barberini, Urban VIII. and his nephews, because they had also endeavoured to get all his manuscripts prohibited. In this rancorous spirit he cast his Courier into a new model, and enlarged it with many letters and discourses. Thus new modelled, he offered it to a bookseller, who undertook to get it printed; but our author was betrayed by a pretended friend, who acted the part of a spy, and informed the Archbishop of Vitelli, then the pope's nuncio at Venice, just as the work was finished at the press; and upon the complaint of the nuncio, Pallavicini was imprisoned. In this miserable condition he found a friend in one of his mistresses, who, seeing him abandoned by most of his patrons, not only supported him, but conveyed letters to him, by which she gave him such information as enabled him to make a proper defence, and to recover his liberty.

But a war having in the mean time broken out between the Barberini and the Duke of Parma, Pallavicini, in order to revenge himself upon the supposed instruments of his imprisonment, wrote a piece entitled *Buccinata, ovvero Butarella, per le api Barberini*, and dedicated it, in terms of the profoundest contempt, to the nuncio Vitelli. The nuncio, finding that little notice was taken of his complaints on the occasion, procured by bribery one Charles Morfu, a Frenchman, who pretended to pass for a gentleman, to ensnare Pallavicini; and with this view the traitor used his utmost endeavours to insinuate himself into the friendship of Pallavicini, and at length exhorted him to accompany him to France. He declared that his fortune would be made by the extraordinary encouragement which was given to men of letters by Cardinal Richelieu; and the better to favour the deceit, he produced feigned letters from the cardinal, inviting our author to France, and expressing a desire he had to establish in Paris an academy for the Italian tongue, under the direction of Pallavicini. The snare took; and Pallavicini, fascinated by the prospect of gain, suffered himself to be led like an ox to the slaughter. He left Venice much against the advice of his friends, and went first to Bergamo, where he spent a few days with some of his relations, by way of entertaining Morfu. They then set off for Geneva, to the great satisfaction of Pallavicini, who proposed to get some of his works printed there, which he had not been able to do in Italy. Morfu, however, instead of conducting him to Paris, took the road to Avignon, where, crossing the bridge of Soraces, in the county of Venaissin, they were seized by a gang of *sbirri*, on pretence of carrying contraband goods, and confined. Morfu was quickly discharged, and very liberally rewarded; but Pallavicini, being carried to Avignon, was imprisoned; and notwithstanding he made a very skilful defence, it was all in vain. The sentence had already been brought from Rome, and he was to undergo trial, merely for form's sake. Being now put into a dark dungeon, he made an abortive effort to escape. He managed matters so well with his keeper as to procure wax-candles to be allowed him, under pretence of amusing himself with reading, and when he had got a number of these, he one night set fire to the prison door, in order to get off by that means; but the stratagem did not succeed, and he was of course subjected to closer confinement, and treated with greater inhumanity than before. After a year's suffering, he was brought to trial, in which he made an excellent defence, and flattered himself with hopes of relief. He had even begun a whimsical piece on the subject of melancholy; but, contrary to his expectations, he was sentenced to die, and lost his head on a scaffold, in the flower of his age.

Pallavicini was of so heedless and profuse a disposition, that had he possessed an immense estate he would have spent it all. On the other hand, no one could be more sincere and faithful in his friendships, nor was there ever a greater victim to treachery; yet, when released from prison in Venice, being told that a wretch had betrayed him, he could not be prevailed upon to believe it, saying, "How can this be, since he declared himself my friend, and I made him privy to all my concerns?" Whilst he wore a religious habit, he used to study or write two or three hours in bed every morning. The rest of the day he spent either in the company of idle persons, or else with the ladies; but after he had wholly left the monastic life, upon pretence of securing himself from the snares of his enemies, he lived in a very irregular manner. He was possessed of a fine genius, had a great facility in writing, and, till he was corrupted by the commerce of lewd women, wrote pieces worthy of immortality.

Palleeangan. Pallet. Palliser.

PALLEEANGAN Isle, a small, low, woody island, one of the Sooloo archipelago, having a salt-water lake in the centre.

PALLET, amongst painters, a little oval table, or piece of wood or ivory, very thin and smooth, upon which the painters place the several colours they have occasion for, to be ready for the pencil. The middle serves to mix the colours on, and to make the tints required in the work. It has no handle, but, instead thereof, a hole at one end to put the thumb through, and thus hold it.

Pallet, amongst potters, crucible makers, and others, a wooden instrument, indeed almost the only one they use, for forming, beating, and rounding their works. They have several kinds of pallets. The largest are oval, with a handle; but others are round, or hollowed triangularly; and others, again, are like large knives, serving to cut off whatever is superfluous on the moulds of their work.

Pallet, in gilding, an instrument made of a squirrel's tail, to take up the gold leaves from the pillow, and to apply and extend them on the matter to be gilt.

Pallet, in *Heraldry*, is nothing but a small pale. Upon one shield there are sometimes several pallets.

PALLIATÆ, a name which the Romans gave to such plays as laid the plot in Greece, and required the performers to appear in Grecian habits. It is used in contradistinction to *togatæ*, in which the scene was laid at Rome, and in which the dresses were Roman. The word *palliatæ* is derived from *pallium*, which was a part of dress peculiar to the Greeks; whereas the *toga* belonged exclusively to the Romans.

PALLISER, Cape, on the south coast of Eaheinomauwe, is the most northern island of New Zealand, and the north-east point of Cook's Strait. Long. 183. 58. W. Lat. 41. 34. S.

Palliser's *Islands*, a cluster of small islands in the South Pacific Ocean; the largest about fifteen miles long and nine broad, being connected by a reef of coral rocks, difficult of access. Long. 146. 30. W. Lat. 13. 38. S.

PALLIUM, a word often mentioned in our old historians. Durandus tells us that it is a garment made of white wool, after the following manner, viz. The nuns of

St Agnes offer every year, on the feast day of their saint, two white lambs on the altar of their church, during the time of singing the *Agnus Dei*, in a solemn mass; and these lambs are afterwards taken by two of the canons of the Lateran church, and by them given to the pope's subdeacons, who send them to pasture till shearing time, when they are shorn, and the pall is made of their wool mixed with other white wool. The pall being thus made, is carried to the Lateran church, and there placed on the high altar, by the deacons of that church; and after the usual watching, it is carried away in the night, and delivered to the subdeacons, who lay it up safe. The *pallium* signifies the plenitude of ecclesiastical power; and therefore it was the prerogative of the popes, as the successors of St Peter, to invest other prelates with it. At first this was done nowhere but at Rome; though afterwards the ceremony was performed at other places.

Pallium, in *Antiquity*, was an upper garment or mantle worn by the Greeks, as the *toga* was by the Romans. These habits were so peculiar to the two nations respectively, that *Palliatus* was used to signify a Greek, and *Togatus* a Roman.

PALM has amongst almost all nations been regarded as an emblem of victory, and assigned as the reward of it. The reason why this tree was adopted and made use of to represent victory, is said to be, because it is so elastic, that if pressed by the greatest weight, it will rise superior to the pressure, and be able to restore itself to its former state, appearing almost invincible.

Palm *Islands*, a chain of islands near the north-eastern coast of New Holland, extending almost thirty miles in length, at the entrance of Halifax Bay. Long. 213. 25. W. Lat. 18. 53. S.

Palm-Sunday, in the Christian church, the Sunday next before Easter, being so called in memory of our Saviour's triumphal entry into Jerusalem, when the multitude who attended him strewed palm branches on his way.

PALMA, one of the Canary Islands, situated off the coast of Western Africa. The soil of this island is more elevated than Teneriffe, being hilly, and full of caverns. It is generally fertile and populous only on its coasts, where are cultivated vegetables, good wine, a great deal of sugar used principally in preserving fruit, in which the island abounds, and a great quantity of almonds. In its southern part Palma is very barren, being strewed with the products of volcanic action. The centre is often covered with snow, and contains extensive pine forests, as well as good timber for ship-building. The region of clouds only is thickly wooded, which gives the island the appearance of a forest when seen from a distance. Tradition says that the Spaniards gave it the name which it bears, from its having a resemblance to a palm-tree when seen from the ocean. The produce in corn is not sufficient for the consumption of the inhabitants, so that in years of scarcity they live on the roots of fern, as at Gomera, another of the group. According to Clavijo, there are neither fallow-deer, partridges, nor hares on this island; but rabbits are very numerous, and destructive to the young trees. One of the principal branches of trade is the fishing, which is prosecuted on the coast of Africa in small vessels. The fish being salted, serves, with potatoes, for the food of the common people throughout the islands. Palma is one of the three royal islands, and had a liberty to trade with America, which was not taken advantage of; its commercial intercourse being almost entirely with Teneriffe, and Spain, the mother country. Volcanic eruptions have repeatedly spread ruin and consternation throughout Palma, and its liability to these terrible visitations it shares with Teneriffe and Lanzerota. Santa Cruz de las Palmas, the capital, has a good port. Palma is about twenty-five miles in length by fifteen miles in breadth, and contains about 25,000 inhabitants.

Palma, the capital of Majorca, one of the Balearic Islands, belonging to Spain, in the Mediterranean Sea. It has a most excellent harbour, formed by Cape Calafiguera and Cape Blanco, and is very respectably fortified. The city contains 30,000 inhabitants, subsisting on the produce of the fertile fields that surround them, on that of the fisheries, and by means of considerable foreign commerce in silk, thread, oranges, lemons, dates, almonds, and flax. It is the see of a bishop, and has a large cathedral, an academy for drawing, a literary seminary, and, which is the best of the buildings, a large mercantile exchange. The cathedral, by accurate observation, is in east longitude 3. 9. 45. from London, and in north latitude 39. 34. 4. It has a mole 4380 feet long. It contains 3000 large houses, and 29,529 inhabitants.

Palma, a town of the island of Sicily, in the intendancy of Calatinata, and district of Mazzara. It is situated on a fine plain, near gentle hills, on the sea-shore, eighty-six miles from Palermo. It is a healthy place, with 8400 inhabitants, who deal in wine, corn, honey, and other productions of their fertile soil.

Palma, a town of Italy, in the province Terra di Lavoro, of the kingdom of Naples. It stands on a fertile plain, and contains 6300 inhabitants.

PALMAS, Las, capital of the Great Canary, one of the group of the Canaries, situated off the coast of Western Africa. It is a large handsome town, and in 1835 contained 18,000 inhabitants. There are a cathedral, an hospital, and a college, with convents for monks and nuns of all orders. The city is well supplied with water, having fountains in all the principal streets and squares; and there is a public market, which is always abundantly stocked with provisions.

PALMERSTON Island, in the South Pacific Ocean, discovered by Captain Cook, and afterwards visited by Captain Wilson in the missionary ship Duff. It has the appearance of one island, but consists really of eight or nine. There are no inhabitants on the island, but numerous rats, supposed to have been drifted here on some hollow tree or root. Long. 163. 10. W. Lat. 18. 4. S.

PALMI, a city of Italy, in the province of Calabria Ulteriore I., of the kingdom of Naples. It stands on the sea, in a district highly productive of silk, wine, and oil. It contains 6100 inhabitants, many of them employed in woollen and silk manufactures. It was almost wholly destroyed by the earthquake of 1783, but has since been rebuilt.

PALMIRAS, a celebrated point of land at the head of the Bay of Bengal, which all vessels bound for Calcutta endeavour to make, and on which the East India Company have erected a lighthouse. Long. 87. 5. E. Lat. 20. 44. N.

PALMISTRY, a kind of divination, or rather a deceitful art practised by gipsies, who pretend to foretell events by looking upon the lines and marks of the hand.

PALMUS, a long measure used both by the Greeks and the Romans. The Grecian *palmus* was of two sorts; the greater, which contained nine finger-breadths, and the less, which contained four. The Roman *palmus* was also of two sorts; the greater, which contained twelve finger-breadths, or eight inches and a half English; and the less, which contained four finger-breadths, or nearly three inches English. The great *palmus* was taken from the length of the hand or span, the less from the breadth of it.

PALMYRA, or Tadmor, a noble city of ancient Syria, now in ruins. The origin of this name is uncertain, neither is it well known by whom the city was built; for though, from the identity of the names, it is thought by many to have been the *Tadmor in the wilderness* built by Solomon,[1] yet this point is much controverted by many learned men.

[1] See 1 Kings, ix. 18; and 2 Chron. viii. 4; and Josephus, *Antiq. Jud.* lib. i.

Palmyra.

For the world have long and justly been astonished to find in the desert of Syria, at a distance from the sea, with a very precarious and scanty supply of water, and without a particular connection with any great monarchy, ruins of a city more extensive and splendid than Rome itself, the depositary of all the arts which Greece in its most flourishing periods could display. The problem is an intricate one; yet when we divest it of many of its difficulties, we shall perhaps reduce this stupendous prodigy to no very uncommon magnitude. The coast of Syria was in early times rich and populous; and, either from the convenience of procuring water, or from the vicinity of India and Egypt, the population, instead of increasing on the mountains, extended to Judea, and thence through its plains only to the internal parts. Traces of this numerous people, and the ruins of their habitations, still remain; but as their edifices were not uncommonly splendid, or as the causes of their destruction were powerful, they have not attracted much attention. Yet the ruins of more than thirty towns are discoverable to the south-east of the Dead Sea, and thence towards Tadmor or Palmyra; we know the cause of the destruction of these towns, and we know that it did not reach Palmyra. This splendid city was not, therefore, insulated in a mass of sand; it was probably a link of a continued chain of population, or perhaps its termination. The situations of towns in the sandy desert must necessarily be determined by local advantages. Tadmor is situated on a spot where two hills converge, and beyond the point where they approach. These hills afforded water; and the aqueducts through which it was brought from them were discovered and described by Mr Wood. Though the other towns now in ruins exhibit some remains of luxury and opulence, yet in these respects they are much inferior to Palmyra; and this deserves to be here explained. Palmyra was undoubtedly very ancient. "The two springs of fresh water it possesses," says Volney, "were, above all, a powerful inducement in a desert everywhere else so parched and barren. These, doubtless, were the two principal motives which drew the attention of Solomon, and induced that commercial prince to carry his arms so remote from the limits of Judea."[1] "He built strong walls there," says the historian Josephus, "to secure himself in the possession, and named it *Tadmor*, which signifies the Place of Palm-trees." Hence it has been inferred that Solomon was its first founder; but from this passage we should be rather led to conclude that it was already a place of known importance. The palm-trees he found there are not the trees of uninhabited countries. Prior to the days of Moses, the journeys of Abraham and Jacob from Mesopotamia into Syria sufficiently prove that a communication existed between these countries, which must soon have rendered Palmyra flourishing. The cinnamon and pearls mentioned in the time of the Hebrew legislator demonstrate a trade with India and the Persian Gulf, which must have been carried on by the Euphrates and Palmyra. At this distance of time, when the greater part of the monuments of those early ages have perished, we are liable to form very false opinions concerning the state of these countries in remote times, and are the more easily deceived, sometimes admitting as historical facts antecedent events of an entirely different character. Observing, however, that men in all ages are united by the same interests and the same desires, we cannot help concluding, that a commercial intercourse must early have taken place between one nation and another, and that this intercourse must have been nearly the same with that of more modern times. Without, therefore, going higher than the reign of Solomon, the invasion of Tadmor by that prince is sufficient alone to throw light upon the history of this city. The king of Jerusalem would never have directed his attention to so distant and detached a spot, without some powerful motive of interest; and this interest could be no other than that of an extensive commerce, of which this place was already the emporium. This commerce extended itself to India; and the Persian Gulf was the principal point of union.

From the nature of the commodities, from the requisite assistance of the Tyrians, and other forcible arguments, Volney shows that the Persian Gulf was the centre of the most ancient commerce of the eastern world; and that it was with a view of obtaining a shorter route, by means of the Euphrates, that Solomon turned his attention to Tadmor, distant only three days' journey. "We may even reasonably conjecture," says Volney, "when we reflect on the revolutions of the following ages, that this commerce became a principal cause of those various wars in Lower Asia, for which the barren chronicles of those early times assign no motives. If, after the reign of Solomon, the Assyrians of Nineveh turned their ambitious views towards Chaldea and the lower part of the Euphrates, it was with the intention to approach that great source of opulence, the Persian Gulf. If Babylon, from being the vassal of Nineveh, in a short time became her rival, and the seat of a new empire, it was because her situation rendered her the emporium of this lucrative trade; in short, if the kings of this great city waged perpetual wars with Jerusalem and Tyre, their object was not only to despoil these cities of their riches, but to prevent their invading their trade by the way of the Red Sea. An historian who has informed us that Nebuchadonosor, before he laid siege to Jerusalem, took possession of Tadmor, clearly indicates that the latter city acted in concert with the two neighbouring capitals. Their gradual decline became, under the Persian empire, and the successors of Alexander, the efficient cause of the sudden greatness of Palmyra in the time of the Parthians and the Romans; she then enjoyed a long peace for many centuries, which allowed her inhabitants to erect those monuments of opulence whose ruins we still admire." If the former observations showed the connection of this remote spot with a more populous country, these remarks explain the cause of the renovation and magnificence of this city. Cairo, in another, probably a subordinate route, never attained the splendour of Palmyra; but the genius of the Egyptians, and perhaps the laws of Egypt, prevented it.

There is, however, no authentic history of Palmyra till after the capture of the Emperor Valerian by the Persians. It is first mentioned by the Roman historians as a place which Marcus Antonius attempted to plunder, upon pretence that it had not observed a just neutrality between the Romans and Parthians. Pliny takes notice of it as being situated in a rich soil, amongst pleasant streams, and totally separated from the rest of the world by a vast sandy desert, which had preserved its independence between Parthia and Rome. There is still a considerable spot of good soil next the town and on the hills; and even in the wilderness there were palm and fig trees, some of which remained till the latter end of the seventeenth century, though not one is now to be found.

After the captivity of Valerian, it became an opulent city, to which its situation in the vicinity of the Roman and Parthian empires greatly contributed; since the caravans, in going to or returning from the East, frequented the place, and thus rendered it a considerable seat of merchandise. It enjoyed independence till the time of Trajan, who, having made himself master of almost all the Parthian empire, likewise reduced Palmyra, which was afterwards accounted part of the Roman dominions. But when the defeat and captivity of Valerian had so much

[1] Travels through Syria and Egypt.

weakened the empire that the Persians seemed to be in a fair way of becoming masters of all the eastern provinces, the Palmyrans began to entertain thoughts of recovering their liberty. Odenathus, prince of Palmyra, sent a respectful letter to Sapor on his return, accompanied with considerable presents; but by that haughty conqueror his letter and embassy were treated with contempt. The presents were thrown into the Euphrates; and to the letter Sapor replied, that the insolence of the prince in presuming to write to his lord was inexcusable; but if he could atone for it in any way, it would be by presenting himself before the throne, bound hand and foot, in token of consciousness of his crime, and the punishment he deserved. This injurious treatment so provoked Odenathus, that he swore either to humble the pride of the haughty conqueror, or to die in the attempt. Accordingly, having assembled all the forces he could muster, he fell upon the Persians, destroyed a number of them, and took a great part of their baggage, with some of the king's concubines. Of the war of Odenathus with the Persians, however, very little is known, except that, though the latter were often vanquished, and the independence of Palmyra established for the present, yet Valerian was never released from his captivity, though Odenathus earnestly wished to have the honour of rescuing him from his enemies.

Odenathus enjoyed his sovereignty but a very short time, being murdered by his nephew, who was soon afterwards put to death by Zenobia, the wife of Odenathus. This lady is said to have been possessed of extraordinary endowments both of body and mind; having, according to Mr Gibbon, been almost the only Asiatic woman who is recorded to have overcome the obstacles arising from the confined situation of the fair sex in that part of the world. Immediately on taking vengeance for the murder of her husband, she assumed the government, and soon strengthened herself so much, that she resolved to submit neither to the Roman nor the Persian rule. The neighbouring states of Arabia, Armenia, and Persia, dreaded her enmity, and solicited her alliance. To the dominions of Odenathus, which extended from the Euphrates to the frontiers of Bithynia, his widow added the inheritance of her ancestors, the populous and fertile kingdom of Egypt. The Emperor Claudius acknowledged her merit, and was content, that whilst he pursued the Gothic war, she should assert the dignity of the empire in the East. The conduct of Zenobia, however, was attended with some ambiguity; nor is it unlikely that she had conceived the design of erecting an independent and hostile monarchy. She blended with the popular manners of Roman princes the stately pomp of the courts of Asia, and exacted from her subjects the same adoration that was paid to the successors of Cyrus. She bestowed on her three sons a Latin education, and often showed them to the troops, adorned with the imperial purple. For herself she reserved the diadem, with the splendid but doubtful title of Queen of the East.

When Aurelian passed over into Asia against this singular adversary, his presence restored to obedience the province of Bithynia, already shaken by the arms and intrigues of Zenobia. Advancing at the head of his legions, he accepted the submission of Ancyra, and was admitted into Tyana, after an obstinate siege, by the help of a perfidious citizen. The generous although fierce temper of Aurelian abandoned the traitor to the rage of the soldiers; but a superstitious reverence induced him to treat with lenity the countrymen of Apollonius the philosopher. Antioch was deserted on his approach, till the emperor, by his salutary edicts, recalled the fugitives, and granted a general pardon to all who, from necessity rather than choice, had been engaged in the service of the queen of Palmyra. The unexpected mildness of such a conduct reconciled the minds of the Syrians, and, as far as the gates of Emesa, the wishes of the people seconded the terror of his arms.

Zenobia would have ill deserved her reputation had she indolently permitted the emperor of the west to approach within a hundred miles of her capital. The fate of the East was decided in two great battles, so similar in almost every circumstance, that we can scarcely distinguish them from each other, except by observing that the first was fought near Antioch, and the second near Emesa. In both, the queen of Palmyra animated the armies by her presence, and devolved the execution of her orders on Zabdas, who had already signalized his military talents by the conquest of Egypt. The numerous forces of Zenobia consisted for the most part of light archers, and of heavy cavalry clothed in complete steel. The Moorish and Illyrian horse of Aurelian were unable to sustain the ponderous charge of their antagonists. They fled in real or affected disorder, engaged the Palmyrans in a laborious pursuit, harassed them by a desultory combat, and at length discomfited this impenetrable but unwieldy body of cavalry. The light infantry, in the mean time, when they had exhausted their quivers, remaining without protection against a closer onset, exposed their naked sides to the swords of the legions. Aurelian had chosen the veteran troops, who were usually stationed on the Upper Danube, and whose valour had been severely tried in the Allemannic war. After the discomfiture of Emesa, Zenobia found it impossible to collect a third army. As far as the frontier of Egypt, the nations subject to her empire had joined the standard of the conqueror, who now detached Probus, one of the bravest of his generals, to take possession of the Egyptian provinces. Palmyra was the last resource of the widow of Odenathus. She retired within the walls of her capital, made every preparation for a vigorous resistance, and declared, with the intrepidity of a heroine, that the last moment of her reign and of her life should be the same.

In his march over the sandy desert between Emesa and Palmyra, the Emperor Aurelian was perpetually harassed by the Arabs; nor could he always defend his army, and especially his baggage, from those flying troops of active and daring robbers, who watched the moment of surprise, and derided the slow pursuit of the legions. The siege of Palmyra was an object far more difficult and important; and the emperor, who with incessant vigour pressed the attacks in person, was himself wounded with a dart. "The Roman people," says Aurelian, in an original letter, "speak with contempt of the war which I am waging against a woman. They are ignorant both of the character and of the power of Zenobia. It is impossible to enumerate her warlike preparations, of stones, of arrows, and of every species of missile weapons. Every part of the walls is provided with two or three balistæ, and artificial fires are thrown from her military engines. The fear of punishment has armed her with a desperate courage. Yet I trust still in the protecting deities of Rome, who have hitherto been favourable to all my undertakings." Doubtful, however, of the protection of the gods, and of the event of the siege, Aurelian judged it more prudent to offer terms of an advantageous capitulation; to the queen a splendid retreat, to the citizens their ancient privileges. His proposals were obstinately rejected, and the refusal was accompanied with insult.

The firmness of Zenobia was supported by the hope that in a very short time famine would compel the Roman army to repass the desert; and by the reasonable expectation that the kings of the East, and particularly the Persian monarch, would arm in defence of their most natural ally. But fortune, and the perseverance of Aurelian, overcame every obstacle. The death of Sapor, which happened about this time, distracted the councils of Persia; and the inconsiderable succours which attempted to relieve Palmyra were easily intercepted either by the arms or the liberality of the emperor. From every part of Syria a regular succession of convoys safely arrived in the camp, which was increased by the return of Probus with his victorious troops from the conquest of Egypt. It was then that Zenobia resolved to fly. She mounted the fleetest of her dromedaries; and had already reached the banks of the Euphrates, about sixty miles from Palmyra, when she was overtaken by Aurelian's light horse, seized, and brought back a captive to the feet of the emperor. Her capital soon afterwards surrendered, and was treated with unexpected lenity. The arms, horses, and camels, with an immense treasure of gold, silver, silk, and precious stones, were all delivered to the conqueror; who, leaving only a garrison of six hundred archers, returned to Emesa, and employed some time in the distribution of rewards and punishments at the end of a war which restored to Rome those provinces which had renounced their allegiance since the captivity of Valerian.

When the Syrian queen was brought into the presence of Aurelian, he sternly asked her, how she had presumed to rise in arms against the emperors of Rome. The answer of Zenobia displayed a prudent mixture of respect and firmness: "Because I disdained to consider as Roman emperors an Aureolus or a Gallienus. You alone I acknowledge as my conqueror and my sovereign." But as female fortitude is commonly artificial, so it is seldom steady or consistent. The courage of Zenobia deserted her in the hour of trial. She trembled at the angry clamours of the soldiers, who called aloud for her immediate execution; forgot the generous despair of Cleopatra, which she had proposed as her model; and ignominiously purchased life by the sacrifice of her fame and her friends. It was to their counsels, which governed the weakness of her sex, that she imputed the guilt of her obstinate resistance; it was upon their heads that she directed the vengeance of the cruel Aurelian. The fame of Longinus, who was included amongst the numerous and perhaps innocent victims of her terror, will survive that of the queen who betrayed or the tyrant who condemned him. Genius and learning were incapable of moving a fierce unlettered soldier; but they had served to elevate and harmonise the soul of Longinus. Without uttering a complaint, he calmly followed the executioner, pitying his unhappy mistress, and bestowing comfort on his afflicted friends.

Returning from the conquest of the East, Aurelian had crossed the straits which divided Europe from Asia, when he was provoked by the intelligence that the Palmyrans had massacred the governor and garrison which he had left amongst them, and again erected the standard of revolt. Without a moment's deliberation, he once more turned his face towards Syria. Antioch was alarmed by his rapid approach, and the helpless city of Palmyra felt the irresistible weight of his resentment. We have a letter of Aurelian himself, in which he acknowledges that old men, women, children, and peasants, had been involved in that dreadful execution, which should have been confined to armed rebellion; and although his principal concern seems directed to the re-establishment of a temple of the Sun, he discovers some pity for the remnant of the Palmyrans, to whom he grants the permission of rebuilding and inhabiting their city. But it is easier to destroy than to restore. The seat of commerce, of arts, and of Zenobia, gradually sunk into an obscure town, a trifling fortress, and at length a miserable village.

Little is known concerning the fortunes of Palmyra since the time of Mahommed, except that it was considered as a place of strength, and that in the twelfth century there were two thousand Jews in it. With respect to the ruins, they appear to be of two different and distinct periods: the oldest are so far decayed as not to admit of mensuration, and look as if they had been reduced to that state by the hand of time; the others appear to have been broken into fragments by violence. Of the inscriptions none is earlier than the birth of Christ, and none is later than the destruction of the city by Aurelian, excepting one, which mentions Dioclesian.

Mr Wood is of opinion, that the face of the country which surrounds Palmyra was always the same; but though Palmyra was ever believed to be situated in a wilderness, it does not follow that the wilderness was always of the same extent. It is perhaps more probable, that when Palmyra was first settled, the rich soil mentioned by Pliny extended much farther; for whatever were the reasons for making a settlement there, Palmyra can scarcely be supposed to have invited a greater number of people than it could feed. The palms and fig-trees that were formerly found upon the hills, and in the borders of the desert, that are now totally barren, confirm this opinion. Mr Wood observes, that whilst he was there a whirlwind happened, which raised such quantities of sand as quite darkened the sky: this sand, therefore, might by degrees encroach upon the fertile environs of Palmyra, and reduce the number of inhabitants as it reduced their sustenance, till the few wretched families only were left, who found it difficult to furnish food for Mr Wood and his company, although they did not continue longer than a fortnight among them. It will also appear from history, that what is supposed to have happened here has happened at other places, where such an event was much less probable. On the sea-coast in the neighbourhood of St Pol de Léon, in Lower Bretagne, there is a considerable tract of land, which before the year 1666 was inhabited, but which was rendered uninhabitable by a sand, which, encroaching every year, covered it to the depth of above twenty feet. In the year 1718 it had advanced more than six leagues, and within one league of St Pol; so that it was then thought probable that the town would of necessity be abandoned. This sand is raised by the east or north-east wind, which drives it in clouds with great swiftness, and in a prodigious quantity.[1] It was also attested by the captain of a ship, and all on board, that in the year 1719 there fell in the Atlantic Ocean, at fifteen degrees of north latitude, and at the distance of more than eight leagues from any land, a shower of sand, some of which they produced, and deposited in the academy at Paris.[2]

The company with whom Mr Wood travelled arrived at length at the end of the plain, where a ridge of barren hills, by which it was divided on the right and left, seemed to meet; between them there was a vale, through which an aqueduct formerly conveyed water to Palmyra. On each side of this vale they remarked several sepulchres of the ancient Palmyrans, which they had scarcely passed, when the hills opening on a sudden, they discovered such piles of ruins as they had never seen. They were all of white marble; and beyond them, towards the Euphrates, was a wide level, stretching farther than the eye could reach, totally desolate, without variety, and without bounds. After having gazed some time upon this prospect, which rather exceeded than fell short of their expectations, they were conducted to one of the huts of the Arabs, of which there are about thirty in the court of the great temple. The inhabitants of both sexes were well shaped, and the women, though very swarthy, had good features. They were veiled, but did not so scrupulously conceal their faces

[1] Memoirs of the French Academy for 1718.

[2] History of the Academy, 1772.

Palmyra. Palnaud.

as the eastern women generally do. They stain the ends of their fingers red, their lips blue, and their eyebrows and eyelashes black. They had large rings of gold or brass in their ears and nostrils, and appeared to be healthy and robust. The walls of the city are flanked by square towers, into which some ancient funeral monuments have been converted; but the walls are in most places level with the ground, and sometimes not to be traced. It is, however, probable, by their general direction, that they included the great temple, and were three miles in circumference. The Arabs showed a tract which was near ten miles in circumference, the soil of which was raised a little above the level of the desert: they said that this was the extent of the old city; and that by digging in any part of it, ruins were discovered.'

These ruins consist of temples, palaces, and porticos of Grecian architecture, and lie scattered over an extent of several miles. They were accidentally discovered by some English travellers from Aleppo, somewhat more than a century ago. By far the most remarkable of them is the Temple of the Sun, of which the ruins are spread over a square of two hundred and twenty yards. It was encompassed with a stately wall, built of large square stones, and adorned with pilasters within and without, to the number of sixty-two on a side. Within the court are the remains of two rows of very noble marble pillars thirty-seven feet in height, with their capitals of most exquisite workmanship. Of these only fifty-eight remain entire; but there must have been many more, for they appear to have gone round the whole court, and to have supported a double piazza. The walks on that side of the piazza which is opposite to the front of the castle seem to have been the most spacious and beautiful. At each end of this line are two niches for statues, with the pedestals, borders, supporters, and canopies, carved with the utmost propriety and elegance. The space within this enclosure, which is now filled with the dirty huts of the inhabitants, seems to have been an open court, in the middle of which stood the temple, encompassed with another row of pillars of a different order, and much taller, being fifty feet in height; but of these, sixteen only remain. The whole space contained within these pillars is fifty-nine yards in length, and near twenty-eight in breadth. The temple is no more than thirty-three yards in length, and thirteen or fourteen in breadth. It points north and south; and exactly at the middle of the building, on the west side, there is a most magnificent entry, on the remains of which are some vines and clusters of grapes carved in the most bold and masterly imitation of nature that can be conceived. Just over the door are discerned a pair of wings, which extend along its whole breadth; the body to which they belonged is totally destroyed; and it cannot now certainly be known whether it was that of an eagle or a cherub, several representations of both being visible on other fragments of the building. It is observed of the windows of this building, which were not large, that they were narrower at the top than below. The north end of the building is adorned with the most curious fret-work and bas-relief; and in the middle there is a dome or cupola about ten feet in diameter, which appears to have been either hewn out of the rock, or moulded to some composition which by time is grown equally hard. North of this place is an obelisk, consisting of seven large stones, besides its capital and the wreathed work about it. It is about fifty feet in height, and, just above the pedestal, is twelve feet in circumference. There was probably a statue upon it, which the Turks, in their zeal against idolatry, destroyed. At about the distance of a quarter of a mile from this pillar, to the east and west, there are two others, besides the fragment of a third; so that perhaps they were originally a continued row.

About a hundred paces from the middle obelisk, straight forward, there is a magnificent entry to a piazza, which is forty feet in breadth, and more than half a mile in length, enclosed with two rows of marble pillars twenty-six feet in height and eight or nine feet in compass. Of these there still remain one hundred and twenty-nine; and, by a moderate computation, there could not originally have been less than five hundred and sixty. The upper end of the piazza was shut in by a row of pillars, standing somewhat closer than those on each side. A little to the left are the ruins of a stately building, which appears to have been a banqueting-house. It is built of better marble, and is finished with yet greater elegance, than the piazza. The pillars which supported it were of one entire stone, which is so strong, that one of them which has fallen down has received no injury. It measures twenty-two feet in length, and in compass eight feet nine inches. In the west side of the piazza are several apertures for gates into the court of the palace. Each of these was adorned with four porphyry pillars, not standing in a line with those of the wall, but placed by couples in the front of the gate facing the palace, two upon each side. Two of these only remain entire, and but one standing in its place. They are thirty feet in length, and nine in circumference. On the eastern side of the piazza stands a great number of marble pillars, some of them perfect, but the greater part mutilated. In one place eleven are ranged together in a square. The space which they enclose is paved with broad flat stones, but there are no remains of a roof. At a little distance are the remains of a small temple, which is also without a roof, and has the walls very much defaced. Before the entry which looks to the south is a piazza, supported by six pillars, two upon each side of the door, and one at each end. The pedestals of those in front have been filled with inscriptions both in the Greek and Palmyran languages, which are become totally illegible. Amongst these ruins are many sepulchres; they are ranged upon each side of a hollow way, toward the north part of the city, and extend more than a mile. They are all square towers, four or five stories in height. But though they are alike in form, yet they differ greatly in magnitude and splendour. The outside is of common stone, but the floors and partitions of each story are marble. There is a walk across the whole building, just in the middle; and the space on each hand is subdivided into six partitions by thick walls. The space between the partitions is wide enough to receive the largest corpse; and in these niches there are six or seven piled upon one another.

Many inscriptions have been found at Palmyra which have occupied much of the attention of the learned; and if any thing certain could be derived from them, there is no doubt that they would tend very considerably to elucidate ancient history. See Barthélemy's *Reflections on the Palmyran Alphabet*, published at Paris in 1754. See also *Phil. Trans.* (No. 217 and 218); the first volume of the *Ancient Universal History*; and, above all, the *Ruins of Palmyra, or Tadmor in the Desert*, published by Mr R. Wood, who, with M. Bouverie and Mr Dawkins, travelled thither in 1751. More recent travellers have added but little to the information contained in the works here referred to.

Respecting the latitude and longitude there are still various opinions. The estimate which appears to be nearest the truth fixes its situation in long. 38. 50. E. and lat. 33. 20. N. It stands about fifty leagues south-east of Aleppo, as much from Damascus, and twenty leagues west of the Euphrates.

PALNAUD, a district of the south of India, in the Carnatic, situated chiefly between the sixteenth and seventeenth degrees of north latitude, and on the south side of the river Kistnah. It was ceded to the British in 1801, and is now comprehended in the collectorship of Guntoor.

The chief towns are Macheria, Timerycotta, and Currumconda.

PALO, a town of Diarbekir, in Asiatic Turkey, situated on the banks of the Euphrates, and near the edge of a mountain, the summit of which is covered with ruins, from which quantities of old coins and metals are occasionally dug up. The inhabitants amount to 8000, consisting of Turks, Armenians, and Koords. Earthquakes are frequent; and the houses are ill built. The river flows here with an extremely rapid current; and, from the weakness of the wooden bridge, whole caravans have sometimes been swept away when the river was swollen from the melting of the snows. It is sixty miles north of Diarbekir.

PALOS, a reef of rocks in the Straits of Macassar, near the west coast of Celebes. Long. 119. 15. E. Lat. 0. 24. S. There is a town of the same name on the western coast of the island of Celebes, in a bay to which it gives name. Long. 119. 39. E. Lat. 0. 56. S.

PALPAH, a small district of Northern Hindustan, subject to the Ghoorkali rajah of Nepaul, and situated between the twenty-eighth and twenty-ninth degrees of north latitude. To the south it is separated from Oude by extensive woods and forests, and forms one of the numerous principalities subject to Nepaul, called the Territories of the Twenty-four Rajahs. It is intersected by the river Gunduck, and is mountainous and unproductive. The Gunduck is the principal river. Palpah is also the chief town of the district, being situated amongst the mountains that overlook the Gunduck River. Long. 82. 55. E. Lat. 28. 11. N.

PALREE, a town of Hindustan, in the province of Gujerat, situated near the western boundary, between Therah and Theraud. It contains about 250 houses, or rather huts, principally inhabited by Rajpoots.

PALUDAMENTUM, in Roman antiquity, was a habit which differed but little from the chlamys, except that the latter belonged chiefly to the lower class of people. It was worn by the officers and principal men amongst the Romans in time of war, who were therefore called *Paludati;* and this distinguished them from the common soldiers, who, because they wore the *sagum,* were called the *Sagati.* The *paludamentum* came down only to the navel, was open at the sides, had short sleeves resembling angels' wings, and was generally white or red. It is sometimes used to signify the common soldier's coat.

PALUS Meotis, the ancient name of a gulf between Europe and Asia, to the north of the Black Sea, and now called the Sea of Asoph.

PALY, or Pale, in *Heraldry,* is when the shield is divided into four or more equal parts, by perpendicular lines falling from the top to the bottom.

Paly *Bende* is when the escutcheon is divided by perpendicular lines, which is *paly,* and also by diagonals, which is called *bendy.*

PAMBOON, a town of Celebes, on the west coast, with an indifferent harbour. It is the residence of a rajah. The inhabitants trade with Macassar and Batavia, and barter the cotton cloth which they manufacture, for gold-dust.

PAMER, a high table-land of Asia, upon the western limit of Little Thibet, and bounded on the west by a mountain ridge of the same name. This ridge joins at its southern extremity the chain of Hindu Coosh, and stretches on the north into the territories of Cashmere, separating Chinese from Independent Tartary.

PAMIERS, an arrondissement of the department of Arriège, in France, extending over 521 square miles. It comprehends six cantons, divided into 115 communes, and contains 67,250 inhabitants. The capital is the city of the same name, the see of a bishop, and the seat of the courts of law for the department. It is situated on the left bank of the river Arriège, in a fertile district, producing much wine. It has a cathedral, three churches, 1000 houses, and 6400 inhabitants, employed in making cotton and woollen goods, and hats. Long. 2. 30. E. Lat. 43. 8. N.

PAMPELUNA, or Pamplona, a city of Spain, the capital of the province or kingdom of Navarre. It was the place in which the ancient kings of that country held their court, and whence they exercised the mild government of that very limited monarchy. As a strongly fortified frontier town, it has many historical events connected with it in ancient times. Of a recent date, when Bonaparte had resolved on the subjugation of Spain, this place was deemed of so much importance to the success of his cause, that it was seized by an act of treachery, and employed as a depôt for the supplies brought from France. After the French were driven out of Spain, it surrendered to the allied armies. In the civil war which still distracts Spain, it was held by the queen's party, when, from want of pay and provisions, a bloody mutiny broke out amongst the troops, who murdered some of their officers, and compelled others to join them. After a time this mutiny was in some measure appeased; and the queen's general, Espartero, having entered the place, an inquisition was held, when such bloody sacrifices of life were offered as have scarcely ever been known, except in France, in modern times.

In describing this city, a view of it can only be given as it appeared before the recent dreadful events. It is finely situated in the centre of a circular plain, called the Cuença, bordered with hills of no great height, which are projections from the Pyrenean range of mountains. The river Arga runs through and fertilizes the plain, which is highly cultivated, and very productive. It has a castle and fortifications, which are nearly impregnable. The streets are wide and clean, the houses are well built, and the place is most copiously supplied with good water from several fountains. It is the seat of a bishop, and of the provincial government and courts of law. Besides a fine old cathedral, it has four splendid churches, thirteen monasteries, four hospitals, a college, 1650 dwelling-houses, and 14,500 inhabitants. There are, or at least were, manufactures of woollen cloth, of parchment, of leather, of pottery and china ware, and of wax-tapers for churches and chapels. It is in longitude 1. 9. 50. W. and latitude 42. 49. 57. N.

PAMPER, a town of Hindustan, in the province of Cashmere, and district of Vehy, being situated on the north side of the Jhylum River. Long. 73. 13. E. Lat. 34. 19. N.

PAMPHILUS, a celebrated painter of Macedonia, in the age of Philip. He was the founder of the school of painting at Sicyon; and he made a law which was observed not only in Sicyon, but all over Greece, that none but children of noble and dignified persons should be permitted to learn painting. Apelles was one of his pupils.

PAMPLONA, a province of Colombia, in the department of Boyaca. It is separated from Socorro on the south by the river Galinazo or Sogamoso; on the west from Mariquita and Rio Hacha by the great Magdalena; on the north it is bounded by Maracaybo, Rio Hacha, and Merida; and on the east by Varinas, at that part of the country where are collected the waters of the valley of Savateca, the sources of the Apure, a tributary of the Orinoco. The eastern branch of the Andes almost fills this province, and forms numerous valleys, by which the inhabitants easily communicate with the Gulf of Mexico by the Zulia, which forms a confluence with the Catatumba, near the Lake of Maracaybo. The towns situated to the west have likewise easy communications by the Sogamoso and the Canaverales, both navigable rivers. There are other streams besides, which are valuable to Pamplona in an agricultural or commercial point of view. The mineral riches of

Pamplona. this province are little known. It is reported that immense quantities of gold were obtained from the mines of Beta and Montuosa; and, in fact, the remains of great works can still be traced. Now, however, comparatively little is obtained, and that is conveyed to Giron by the waters which form the Canaverales. The sand of this river contains gold of twenty-three carats. There are also silver mines, and the metal which they yield is at the rate of eight ounces to one quintal of ore. The copper mines are rich; but from the very awkward manner in which they have been worked, they have proved of little benefit to the country. The soil of the territory upon which the city of Pamplona is built abounds with mica, which is occasionally found in large sheets, and is split into thin plates, which answer as a substitute for window-glass. Fancy articles of various kinds are likewise manufactured from it. Quartz, felspar, and granite are everywhere met with; and the whole geological features of the country attest the metallic and mineralogical wealth of Pamplona; but from the works being wretchedly conducted, it might as well be at the bottom of the Atlantic.

The soil of this province is upon the whole fertile, but the country remains comparatively a desert, from the indolence of the inhabitants. The district in which the capital is situated produces wheat, oats, maize, celery, cabbages, beans, French beans, and an infinite variety of other vegetables. Here they also cultivate some indigenous plants which are very useful, such as the common pine, the resin of which is used medicinally; the myrica, which produces the wax called laurel; a galium, the root of which furnishes an excellent yellow dye for cottons; and also several other kinds of dye-stuffs. One of the most remarkable spots of this district is Surata, the climate of which place is temperate. Ten thousand loads of meal are annually prepared here, the greater part of which passes through Ocaña, a place dependent on the province of Maracaybo, on its way to Monpox and Carthagena. The wheat is generally of an excellent quality, and affords two crops in the course of the year. At other places in this district wheat, sugar-cane, and rice are cultivated; but in none of the villages, with the exception of those of Mantanza and Ecce Homo, in the valley of Surata, is sufficient corn gathered to admit of exportation. The olive-tree is very common at Pamplona; but the mode of preparing the oil is either not known or not practised. In the valley of Taupa the nopal is literally laden with the cochineal insects, which are sent into the province of Tunja. Cotton is cultivated in the district of Giron, particularly in the parish of Rio Negro; and great quantities of it are annually sent to Monpox and Carthagena. Near to the parish just named an abundant amber mine has been discovered. The tobacco raised at Giron is of a very superior quality; and the entrepôt established at Piedecuesta contributes to the comfort of the people. Cocoa, of which considerable quantities are disposed of, succeeds very well on the banks of the Sogamoso, Surata, and Canaverales. These countries also furnish large quantities of capaiva balsam, and some building timber. If the road were open from Giron to the Magdalena, this place would enjoy very great commercial advantages. By this means the rocks of the Sogamoso, so destructive to boats, would be avoided; and, besides, a vast extent of unknown lands, situated between the Sogamoso and the Canaverales, would thereby be much frequented. The navigation of this river is far preferable to that of the other, although its waters are too shallow to allow very deeply laden vessels to traverse them. This stream is of great utility to the inhabitants of Rio Negro, who transport their grains by it much more quickly and cheaply than by Ocaña. Great quantities of Brazil wood are found at some places on the Sogamoso; and on the banks of other rivers there are several very fine cocoa plantations. The Cucuta cocoa, called Magdalena cocoa, from its being brought down by that river, is very much esteemed. Coffee and indigo are likewise cultivated in the province, but of much inferior quality to the cocoa. The fertility of the soil is not the only cause of the abundance of the cocoa-trees; the care of the cultivators contributes much to it. Experience has taught them to protect this plant by the shade of the ceibas and erytahrinas, and to surround them with flourishing hedges of citrons, fagaras, and acacias, which are highly ornamental as well as useful. The inhabitants also carefully water the cocoa-trees; but great ravages are committed on them by the *tinea falsa*. This insect is likewise very destructive to the corn and grain of the Surata. A considerable quantity of Cucuta silver passes by San Christoval into the Varinas. It is expended in the purchase of mules and cattle, of which nearly ten thousand head are bought annually; for although the province abounds in pastures which promise sufficient food for immense herds of cattle, yet the climate is very unfavourable to the raising of such stock. However, some horses, mules, sheep, and goats are bred; and a tolerably good morocco leather is prepared from the skins of the last. The dearness of meat causes a scarcity of tallow, for which vegetable wax is used as a substitute. A country which has but few articles to export cannot be accounted very rich; and Pamplona would even be very poor, were it not for the extreme division of property, which is the means of diffusing comfort through a great number of families. The llanos adjoining the valley of Savateca would be an advantageous opening for the grains of the country in exchange for cattle, were there any road to facilitate commercial intercourse. This might, however, be effected by following the direction of the valley watered by the Chitoya, which would appear to be one of the head streams of the Apure. By this means Pamplona would be brought into communication with Guiana. Giron might do so likewise with the distant provinces by the same road; and instead of paying very dearly for the provisions which this town draws from the llanos of Casanare by the salt mine of Chita (that article being chiefly derived from this place or from Zipaquira), it would procure them at a moderate price from those of Varinas. This article carries almost all the specie from Giron.

The most flourishing towns of this province are those of St Joseph and of Rosaria de Cucuta, notwithstanding the disadvantages under which they labour from want of an opening for their productions. Their territory, varied by the valleys watered by the Jachira, the Pamplona, and the Zulia, has some fine cocoa plantations. The appearance of Rosaria de Cucuta is extremely pleasing. Surrounded by rich haciendas in excellent cultivation, it stands as it were in the midst of a delightful garden. The perspective at the extremity of each street terminates in a beautiful vista, with high mountains in the back-ground. The town, which is not large, is neat and well built. The houses have a clean appearance, but are not large. The streets are paved, and have a current of water running through the middle. This town will ever be famed in the annals of Colombia, as the place in which the first general congress was held, and where the constitution was framed. It was also the place understood to have been fixed on as the future capital of Colombia, under the name of the City of Bolivar; but such has not taken place. The town of Salazar de las Palmas has declined in proportion as those of the valley of Cucuta have advanced in prosperity. Some rich parishes, however, particularly St Jago and Cayetano, may be reckoned amongst its dependencies. This town owes its name to the great variety of palms which cover that part of the province where it is situated. The different kinds found here are the royal palm, which affords wine and butter; the negro-head palm, the fruit of which can be worked like ivory; the noli and the murap-

Pan. po, which latter is used in covering houses, and the twigs of which are eaten. Much of this province, from being traversed by the Andes, is of course very elevated. The town of Pamplona, situated in 8° north latitude, is about eight thousand feet above the level of the sea. This elevation, however, serves to moderate the temperature, which averages about 60° of Fahrenheit. But the climate is by no means agreeable, on account of the vapours which continually darken the heavens. Pamplona is situated in a valley about a league in extent, and is surrounded on all sides by high hills. It possesses a great many churches; and as the houses stand pretty well apart, from each having a portion of garden-ground attached to it, the city at a little distance has a spacious appearance. The surrounding fields are enclosed by stone walls in a very regular manner, imparting to the scene an air of proprietorship which is not often met with. The effect, however, which Pamplona has, as seen from the adjacent eminences, is considerably abated when the town is entered. It exhibits little of its former wealth and importance. Many of the houses are found to be abandoned, the streets are overgrown with grass, and the gardens are neglected. This city was founded by Pedro de Ursua in the year 1549. The gold and copper mines in the vicinity formerly gave it an importance which it does not now possess. The gold mines of Veta, which are within two days' journey of this place, have not been regularly worked for more than a century; but the Indians occasionally bring grains to sell of a considerable size. Not many years ago a mass of pure gold was found which weighed upwards of six pounds. The parish church of Pamplona is reckoned one of the most handsome in the kingdom. The Jesuits had formerly a college here; and there were also several monasteries, which are now abandoned. The population of this town has been estimated at 3200. It is situated 180 miles west-south-west of Merida, 131 west of Varinas, and 270 north-east of Bogota. There appears to be no other place in this province deserving of particular mention. The whole population of Pamplona, consisting of whites, half-whites, and Indians, has been estimated at 75,000. (R. R. R.)

PAN, the god of shepherds, of hunters, and of all country exercises. But he bore a higher character amongst the earliest Greeks, as well as amongst the Egyptians, from whom his worship was borrowed by the former people. In Egypt he was known by the name of *Mendes*, which, according to Jablonski,[1] signifies fecundity. Hence his symbol was a living he-goat, the most salacious of all animals: "Hircum Mendesium colunt Ægypti, eo quod virtuti prolificæ ac genitivæ consecratus est. Namque animal hoc coitus valde cupidum est." His principal temple was a magnificent building in a city of Lower Egypt, called after his name. It is well known, that from dedicating certain animals to certain gods, the Egyptians proceeded to consider the animals themselves as actuated by the divinities to whom they were sacred. Hence, perhaps, the origin of animal worship. In the temple of Mendes was kept a he-goat, to which sacrifices of a very monstrous kind were offered.

The deity whom the Egyptians adored by the name of Mendes was no other than the Soul of the Universe, for he was their most ancient god; and we are told by Plutarch, "that they took the first God and the Universe for one and the same thing."[2] Hence his name of Παν amongst the Greeks. Not that either the Greeks or their masters in theology worshipped, as their first god, mere brute matter, but that spirit which they conceived to be co-eternal with matter, and to animate all things, making them *one*. Thus Orpheus, who imported the Egyptian doctrine into Greece, declares that all things are one; and after him Parmenides and other philosophers taught ἑν ειναι το παν, that "one is the universe," and that the "universe is immoveable." That the ancient Grecian Pan, or the Egyptian Mendes, was not the corporeal world, as senseless and inanimate, but the whole system of things animated and eternal, appears further from the following testimony of Macrobius: "Hunc deum Arcades colunt, appellantes τον της ὑλης κυϱιον, non sylvarum dominum, sed universæ substantiæ materialis dominatorem." The Arcadians worship this god, calling him the lord of Hyle, that is, not the lord of the woods, but the lord of all material substance. In the same manner Pharnutus describes the Pan of the other Greeks, not as the mere corporeal world, but as the intellectual principle actuating it and presiding over it; and he adds, that "Pan was feigned to be lascivious, because of the multitude of spermatic reasons in the world, and the continual mixtures and generation of things."

The Egyptians, as we learn from Jablonski, had nearly the same notion with the Greeks of the spirit which they worshipped as the soul of the universe, only they ascribed to it both sexes. As the maker, governor, and bountiful father of universal nature, they considered it as a male, whose symbol was the he-goat of Mendes; and as a female it was adored by the name of Isis, to whom the she-goat was consecrated, though not held in such veneration as the male. From this view of the Egyptian creed, the sacrifice which we have mentioned appears no longer unaccountable. It was made to a god, believed to be the universal source of fecundity, and to whom, from the well-known character of the animal which he was supposed to actuate, they had reason to believe that it would be most acceptable.

The Greeks never worshipped their Pan by the emblem of a living goat; but they painted him with the lower parts of a goat, for a reason which will be afterwards mentioned. How he came to degenerate amongst that people, from one of the *Dii majorum gentium*, or rather from the first principle of all things, to the rank of a demon or demi-god, we cannot pretend to say. But that such was his fate is certain, for under this last character mention is made both of his birth and his death.

It is not agreed whose son he was. Homer makes him the son of Mercury, and says he was called *Pan*, from παν, *omne*, because he charmed all the gods with his flute; but others say that he was the son of Demogorgon, and first invented the organ, of seven unequal reeds, joined together in a particular manner. Having upon a time fought with Cupid, the latter in spite made him fall in love with the nymph Syrinx, who, flying from him to the banks of Ladon, a river of Arcadia, was, at the instant prayers of the Nymphs, turned into a reed, as her name in Greek signifies, which the god grasping instead of her, made a pipe of, and for his music was worshipped by the Arcadians. The most common opinion was, that he was the son of Mercury and Penelope. But Naturæ Comes makes his birth scandalous, by saying he was called παν, because begotten by all Penelope's suitors. He was painted half-man half-goat, with large goats' horns, a chaplet of pine on his red face, a pleasant laughter, with the feet and tail of a goat; a motley skin covered his body, and he had a crooked stick in one hand, and his pipe in the other. He is described by Silius Italicus (xiii. 326, *et seq.*) as a sight enough to frighten women and children, nay, even armed men too; for when Brennus the Gaul was about to pillage the temple of Apollo at Delphos, Pan struck such a terror into his army, that he quitted his sacrilegious design; and hence *Panici terrores*. Yet, homely as he was, he pleased the goddess Lu-

[1] *Pantheon Egyptiorum.*

[2] *De Iside et Osiride.*

na, turning himself easily into a white ram (Virgil, *Georg.* iii. 392, *et deinceps*); and also the nymph Dryope, almost putting off his divinity, and turning shepherd, for her sake. Neither was he displeasing to other nymphs, who are generally represented dancing around him to hear the charms of his pipe. The usual offerings made to him were milk and honey, in shepherds' wooden bowls. A dog, the wolf's enemy, was also sacrificed to him; and hence his usual epithet is λυκαιος, and his priests are called *Luperci.*

His festival, celebrated on the 15th of February by the Romans, was brought into Italy by Evander the Arcadian, and revived afterwards by Romulus, in memory of his preserver. He was also called by the Romans Inuus, *ab ineundo.* (Liv. i. 5; Macrob. *Sat.* i. 21; and Serv. *in Virg. Æn.* vi. 775.) The ancients, by giving so many adjuncts and attributes to this idol, seem to have designed him as the symbol of the universe. His upper parts are human, because the upper part of the world is fair, beautiful, and smiling, like his face; his horns symbolize the rays of the sun and of the moon; his red face indicates the splendour of the sky; the spotted skin wherewith he is clothed, the stars which bespangle the firmament; the roughness of his lower parts, beasts and vegetables; his goat's feet, the solidity of the earth; his pipe, compacted of seven reeds, the seven planets, which, they say, produce the harmony of the spheres; and his crook, bending round at the top, the years circling into one another.

Having said so much of Pan, both as a self-existent god and as a generated demon, we shall conclude this article with some observations on Plutarch's account of the prodigy which happened at his death; for, in the Pagan creed, demons were not all believed immortal. "In the reign of Tiberius," says he,[1] "certain persons on a voyage from Asia to Italy, and sailing towards the evening by the Echinedes, were there becalmed, and heard a loud voice from the shore calling on one Thamus, an Egyptian pilot, whom they had on board. Thamus, as may be supposed, listened with attention; and the voice, after repeating his name thrice, commanded him when he came to the Pelodes, to declare that the Great Pan was dead. The man, with the advice of his companions, resolved, that if they should have a quick gale off the Pelodes, he would pass by in silence; but that if they should be becalmed, he would perform what the voice had commanded. Adhering to this resolution, they soon arrived off the destined islands, and were immediately becalmed, there being neither breath of wind nor agitation of water. Upon this, Thamus, looking from the hinder part of the ship towards the land, pronounced with a loud voice, 'the Great Pan is dead,' and was instantly answered from the shore by numberless howlings and lamentations."

This story, which has so much the air of imposture, has not only been admitted as true by men of the first eminence for learning and acuteness, but has been applied to our Saviour, whose death, says Cudworth, the demons mourned, not from love, but from a presage that it would put a period to the tyranny and domination which they had so long exercised over the souls and bodies of men. In support of this opinion, he quotes several passages of Scripture, such as, "Now is the prince of this world judged;" and, "Having spoiled principalities and powers (by his death upon the cross), he triumphed over them in it." He affirms likewise, that "Pan being taken for that reason or understanding by which all things were made, and by which they are all governed, or for that divine wisdom which diffuseth itself through all things, is a name which might very well signify *God manifested in the flesh.*"

The authority of Cudworth is great; but a groundless opinion has seldom been propped by weaker reasoning than he makes use of on this occasion. Plutarch indeed says, and seems to believe, that this prodigy fell out during the reign of Tiberius; but as he mentions not the year of that reign, there is no evidence that it was at the crucifixion of our Saviour. The demons who inhabited the Echinedes knew what had been transacted at Jerusalem, far distant from their islands; they knew the name of the pilot of a strange ship; they knew that the mariners of that ship had resolved to disobey their command, unless becalmed off the Pelodes; they had power over both the winds and waves at the Pelodes, and exerted that power to enforce obedience to their command; and yet these all-knowing and powerful beings were under the necessity of calling in the aid of a man to deliver a message to their companions, inhabiting a place to which the very same story assures us that their own power and knowledge reached. Should it be said that the demons were compelled by divine power thus publicly to make known to man Christ's triumph over the kingdom of darkness, we beg leave to ask why they were not likewise compelled to give him another name, since it is certain, that at the era of Tiberius, and long before, illiterate Pagans, such as common seamen must be supposed to have been, knew no other Pan than the fabled son of Penelope and Mercury? Indeed the other Pan, taken for that reason or understanding by which all things were made, could not possibly be the being here meant. For, erroneous as the Pagan system was, there is nothing in it so completely absurd as the death of the soul of the universe, the maker of all things; nor do we believe that any Pagan ever existed, who dreamed that such a death was possible.

What, then, it will be asked, are we to understand by this story? Plutarch was eminent for knowledge and integrity, and he relates it without expressing a doubt of its truth. But many a man of worth has been credulous; and though that was not his character, this prodigy may be accounted for by natural means. Germanicus was believed to have been poisoned, at least with the knowledge, if not by the command, of Tiberius; and there was nothing which the Romans so deeply deplored as the untimely death of that accomplished prince.[2] They fancied that his body was animated, not by a human soul, but by a superior demon; and they decreed to him statues, religious ceremonies, and even sacrifices. His widow was highly honoured, as having been nearly related to a divinity, and his children were adored as demi-gods. These facts being admitted, nothing appears to us more probable than the opinion of the learned Mosheim,[3] who thinks that some shrewd statesman, in order to excite the popular fury against Tiberius to the highest pitch, invented this story, and bribed foreign mariners to spread it amongst the people, who would naturally believe, that by the Great Pan was meant their favourite Germanicus. This hypothesis is at least countenanced by what Plutarch tells us of the anxiety of the emperor to discover what personage could be meant by the Pan whose death was announced to the seamen. He consulted the learned men of Rome, who, in order to restore peace to the city, declared that they understood it of none other than the son of Penelope and Mercury.

PANAGUR, a town or village of Hindustan, in the province of Malwah, and district of Gurrah, 115 miles south from Chatterpoor. Long. 88. 15. E. Lat. 25. 20. N.

PANAMA, Isthmus of (also the name of a province of New Grenada), is that extraordinary ligature or neck of land which connects the continents of North and South America. It is also sometimes called the Isthmus of Da-

[1] *Lib. de Oracul. Defect.*

[2] Tacitus, *Annal.* cap. 72, 83, *et* lib. iii. cap. 1.

[3] Cudworth's *Intel. Syst.* cap. iv. note 132.

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rien, a name which, however, is much out of use, and ought to be entirely expunged from geographical works.[1] The isthmus of Panama may be considered as extending from the meridian of 77° to that of 81° west of Greenwich. Its breadth at the narrowest, which is opposite the city of Panama, is not less than thirty miles; and it swells out at either extremity, where it becomes blended with the continental portions of the western world. Its whole extent is not, however, comprised within the limits of the province which bears the same name; for to the north-east, the Mandingo Indians maintain a fierce, and not unfrequently a turbulent independence, to the present day. The continuity of the great chain of the Andes, which, for the most part, traverses the whole continent of America, is twice broken within the limits above defined. The Northern Cordillera exhibits the first indication of depression in the province of Nicaragua; but it again elevates itself in the province of Veragua, where it expands into a very fine table-land. In the eastern part of the province it breaks into detached mountains of considerable elevation, and of the most abrupt and rugged formation. Still farther to the east, innumerable conical mountains make their appearance, only three or four hundred feet in height, and having their bases skirted by plains and savannahs. These finally disappear, and the country becomes almost uninterruptedly low and flat. Again the conical mountains thicken, and becoming connected, form a small cordillera, which runs from about opposite Portobello to the bay of Mandingo, where the second break occurs. The land then continues low for a considerable distance, and abounds in rivers, those on the north side flowing to the Gulf of Uraba or Darien, and those on the south to that of St Miguel; beyond which point the cordillera again raises itself on an extended scale, and enters South America. The general bearing of the mountains in the vicinity of Panama is north-east and south-west. They vary elsewhere, and appear to maintain some relation to the line of coast, although they do not always run parallel to it. Their height is not considerable. Near Panama they do not exceed 1000 or 1100 feet in elevation. East of Portobello, however, they are considerably higher, and are generally covered with a dense and almost impenetrable forest, which grows on a soil of great depth and extraordinary fertility. Mr Webster, another traveller in this region, observes, with regard to the mountains of the isthmus: "The mountains which I enumerated were measured by us, and found to be less than 2000 feet high. The principal ingredients of the hills are hornblende, jasper, hornstone, and trap-porphyry; basalt, agate, and quartz rock. A crumbly arenaceous quartz rock prevails near Chagres, containing iron, pyrites, and lead. The stones at Portobello have the volcanic character; and the sand on the beach is of a black description, like that of Fernando Noronha. The streets of Portobello are paved with basalt nodules. Quartz rock is very abundant throughout the isthmus, in many varieties; several beds of clay, boles, ochres, and fullers' earth, are also to be found." Limestone is the prevailing rock, which is skirted on the south side with indurated clay, and on the north with coral rock. The latter is impregnated with a singular gelatinous matter, which imparts to it the property of firmly adhering under water to whatever it comes in contact with. It is easily dug out of the earth, but on exposure to the air it becomes very hard and close in the texture. It thus forms an excellent building material, as does the indurated clay. Besides limestone, flint, calcedony, jasper, and ironstone are found in the interior; and near Gatun, on the river Chagres, there is a very fine fire-stone of great utility in the construction of grates, furnaces, and other things which require to stand a high degree of heat. In building materials of all kinds, indeed, Panama is unusually rich; but in the precious metals it is poor. In Panama proper only two mines are worked, Santa Rita and Pequeni, both for gold; but their produce is insignificant. They are situated in the mountains near Portobello. In Veragua and Choco, very pure gold is obtained in considerable quantity by washing; copper and iron are abundant; and mercury and tin are also said to have been found. But very little capital is embarked in the respective works, and the total amount obtained, either by mining or by washing, is comparatively small and uncertain from year to year.

This province abounds in rivers, and in the rainy season every mile of land is intersected by a flowing stream, which carries off the surplus water. These disappear during the summer heats; but the following remain permanently, and are considered by Mr Lloyd as worthy of particular description. On the northern side of the isthmus, and consequently flowing into the Atlantic, are the Chagres, Pequeni, Trinidad, and Gatun, which all unite and form one large river before they reach the ocean; and on the south side, and falling into the Pacific, are the Rio Grande, Caymito or Chorrero, Pacoro, Indio, and Ballana or Chepo. The Chagres rises in the mountains which approach the Bay of Mandingo, a considerable distance to the eastward of Portobello. After traversing a great tract of country, when nearly opposite to Portobello it receives the Pequeni, which comes from the south-east, and is of equal magnitude with itself. The united streams form a noble river, but flowing so rapidly, and broken into so many falls, as to render navigation very dangerous, even for canoes. Its velocity abates as it approaches the sea; and at the town of Cruces, which is twenty-three miles direct from the Atlantic, it seldom exceeds from three to three miles and a half per hour, even in the rainy season. Still nearer to the ocean, it rapidly decreases, so that in summer its current is scarcely perceptible. "Few rivers of its size," says Mr Lloyd, "present more beautiful scenery on its banks than does the Chagres above Cruces. For miles together, it is bounded by enormous, abrupt masses of limestone, of the most curious and fantastic forms; in other parts savannahs extend to the very edge of the river, covered with a particularly fine grass called grammallotti; and the noble bongo tree is seen studding the banks, somewhat in the shape of a well-trimmed yew-tree, but growing to a much larger size. In most places the river is shaded from the sun's rays by a large tree called jigeron, which extends its branches across the river, its leaves being eagerly sought by the fish. The water generally runs over a bed of variously coloured pebbles, and is in summer most brilliantly clear. In many places near its source it is much wider than at its mouth, occasionally breaking into distinct channels, and forming small islands; but in the rainy season these are all connected, and constitute one broad stream, with strong sets and eddies, caused by the abrupt turns, which render its navigation peculiarly perilous." The river Trinidad enters the Chagres about twenty-four miles from its mouth, and is also a large river. It has its origin

[1] We are enabled to present a pretty full account of this hitherto imperfectly described portion of America, from the following circumstance. In November 1827, Mr Lloyd, who had served for some time previously on General Bolivar's personal staff, received from him a special commission to survey the isthmus of Panama, in order to ascertain the most eligible line of communication across it, whether by road or canal. The notes which he made on this occasion have been published in the first volume of the Journal of the Royal Geographical Society; and from the article containing these our account is principally derived. The result of his operations, in so far as they regarded the level of the respective seas, and the elevation of the intervening isthmus, will be found detailed at length in the Philosophical Transactions for 1830, p. 59.

 very near the south coast, not far from the town of Chorrera. Canoes of various descriptions navigate this river as far as a large town called Capua, which lies south-west of Chorrera, and bring down produce to Chagres. As high as Mr Lloyd went up, which was not, however, as far as Capua, he found it about two hundred feet in breadth, from twenty to twenty-eight feet in depth, and without falls or any other impediment to easy navigation. The river Gatun is also of considerable consequence, although neither very wide nor very deep. It rises in the mountains east of Portobello; and crossing both the roads leading from that city to Panama, joins the Chagres in front of the town of Gatun, about eight miles from the sea. Some considerable lakes exist in the vicinity of its embouchure; and although it is shallow and encumbered with trees during its course, it is very useful as a shelter for shipping during tempestuous weather. With the united assistance of all these rivers, the navigation of the Chagres below the junction of the Trinidad is easy, and very superior to that of some streams of much larger size. The depth below Gatun varies from twenty-six to thirty feet; above that it is twenty-four, and nowhere falls permanently below twenty-two. The banks are wooded to the very edges, and so precipitous that vessels can almost everywhere be brought close to them. The Rio Grande rises to the north-west of Panama, near a mountain called Pedro Miguel, and after receiving some considerable tributaries, becomes navigable for large canoes two leagues above its mouth, which is about two miles from the city of Panama. It is obstructed by a bar, but the tide rising eighteen feet in spring floods, vessels readily enter and find good anchorage within. In some places the Rio Grande very nearly approaches the Obispo, one of the affluents of the Chagres; and much interest was consequently at one time taken in the circumstance, from an idea that the long-wished-for communication between the two oceans might thus be effected. The shallowness of the stream, however, presents an insurmountable objection to this plan. The Caymito, or Chorrera, falls into the Pacific ten miles west of Panama, and is formed by the union of numerous insignificant streams, which take their rise in different parts of the western cordillera. The mouth of this river is not obstructed by a bar, but the tide runs so strongly into and out of it, that the anchorage for shipping is bad, and exposed. It is infested by a prodigious number of alligators, and hence its name, Caymito. Before reaching the Pacific, the Pacora and Indio unite, near the island of Chepillo, about eighteen miles east of Panama, and form a broad, rapid, and winding stream for several leagues above its mouth. On the banks of the Indio an English resident in Panama erected a saw-mill, capable of sawing from fifteen to twenty thousand boards annually. An inexhaustible supply of the finest timber is found in its immediate vicinity; and so great is the fertility of the soil, that a small portion only, laboured by two men, is sufficient to supply ample subsistence for the whole establishment. The river Ballano or Chepo is of great extent, and, under the name of Canada, rises in the province of Darien, near the source of another river called Chucunaque, which falls into the Pacific in the Gulf of San Miguel. The Bellano receives several streams during its course, which is nearly west, and in some degree parallel to the coast for many miles, until it suddenly turns to the southward, and enters the Pacific a few miles east of the Pacora. It is navigable as far as this bend; and on its banks, a little higher up, is situated the town of Chepo, which is of some consequence, as being the assigned place of communication with the Mandingo Indians. Farther on is a fort called Fuerte Terrible, built to prevent their incursions; and the line of the river generally is considered the boundary.

There are two seasons in Panama, namely, summer or the dry, and winter or the rainy season. The former commences about the end of December, and lasts till April; and the latter occupies the intervening months. The quantity of rain which thus falls during the year is prodigious, but its amount varies at different places. The clouds chiefly congregate over the wooded heights, in consequence of a law of nature which universally prevails. At Portobello, which is closely encircled by them, the rain descends in torrents, frequently accompanied by storms of thunder and lightning, terrible and grand in the highest degree. Where the ground, however, is level to any extent, and has been cleared of its wood, a great difference is perceptible; and at Panama the following alternations have been observed. "In April the weather becomes cloudy about noon; but, after drizzling for half an hour, clears up. In May, from nine to eleven, it is dull, with slight rain; the afternoons being still fine. In June there is rain every morning and evening; but the mid-days are fair. As the season advances the rain gradually increases, and is incessant throughout July, August, September, and October. In November the nights are always wet and cloudy, but throughout the days the sky begins to break. December brings a further improvement; and in January, February, and March, a shower of rain is as uncommon as a gleam of sunshine at the other season of the year." One very remarkable phenomenon occurs throughout the whole isthmus. On the 20th of June the rain ceases for five or six days, when the sun shines forth with surpassing splendour; nor is any instance known of irregularity in the recurrence of this extraordinary phenomenon. It is accordingly reckoned on with great confidence by the inhabitants, who call it El Veranito, or little summer, and celebrate the occasion by a jubilee of rejoicing. The temperature and salubrity of the climate also vary in different places. Portobello is one of the hottest and most unhealthy places in the world. At Panama, on the contrary, the thermometer, in the rainy season, does not rise higher at night than 82°, and in the day than 87° of Fahrenheit. The winds are variable and cool; and although the rain is incessant, there is thus no stagnation in the atmosphere, and consequently no epidemic sickness. In summer the temperature rises to 90°, and even as high as 93°; and during the day the reflection of the sun from the smooth surface of the Pacific, with the heat of the winds, which blow steadily from the south-east, over a tract of dry savannahs, makes it very sultry. But the land-winds, which come chiefly from the neighbouring mountains at night, are cool, and the climate may be pronounced generally healthy, although great mortality at times prevails. It is believed, however, that this may be attributed to over-indulgence in the use of some articles of diet, which are unusually abundant at certain seasons of the year.

It appears that a large proportion of the soil of the isthmus of Panama is exceedingly fertile, and the vegetable productions are most luxuriant. In Mr Lloyd's opinion, it challenges competition with any other part of the world in the vigour and variety of its woods. That gentleman gives a list of about a hundred kinds of wood, of excellent or at least good quality, and which are either unknown or little known in Europe. A number of these are very hard and close grained; some resemble box, which must render them very valuable; and others are similar to birch, beech, ash, elm, and those trees which are familiar to us. There are also cotton trees, cedars, lignum-vitæ, a bastard mahogany, fustic, calabash, and so forth. The fruits and esculent vegetables found in the isthmus are those of similar intra-tropical situations. The grains cultivated are rice and Indian corn. The sugar-cane is grown, but not extensively. Coffee and cocoa are cultivated as required for home consumption. The milk-tree (*palo de vacca*), vanilla plant, and caoutchouc tree, are all abundant in the

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woods. With the gum which flows from the last-named production, while it is yet in a liquid state, the inhabitants manufacture a sort of water-proof cloth, on the same principle as in this country; but which, thus prepared, is more uniform in its texture, and never cracks. The charcoal made from many of the trees is considered as excellent for smelting; and as such is exported to Peru, where it is in much request. Indeed, from the hardness of much of the wood, the excellence of the charcoal made from it was to be inferred. The barks of some of the trees are medicinal, or abound in tannin. Ink is made both from gall-nuts and from a bush resembling the caper, called alsifax. Other trees yield very rich and brilliant dyes used by the Indians, but, Mr Lloyd believes, as yet unknown in commerce. Many valuable resins are obtained, particularly one distilled from the bark of a tree called palo santo, or holy tree, which is highly fragrant, and is used not only as a remedy for disorders, but is burned as incense. The styrax officinalis of Linnæus is very abundant, the gum extracted from it selling for two dollars a pound.

The wild animals of the woods are tigers, or rather tiger-cats, which are seldom larger than small Newfoundland dogs; lions, at least so an animal resembling the king of the forest is called; bears; racoons; sajinos, a species of wild boar found in droves; wild hogs in herds; conejos, something like our rabbits, but larger; deer in abundance on the borders of the woods; multitudes of monkeys of various species; together with wild turkeys, both black and coloured; birds resembling our hen-pheasants; pigeons, ducks, and other game, all excellent for food. The most formidable animals are the wild dogs, which, when together in droves, and fired upon, will readily attack one or two men. The tiger does not attack the human species, but preys upon the smaller animals. On the banks of the Pacora, at its mouth, a wild animal is found called macho, or danta, nearly of the size and appearance of a jackass, which, prepared, is considered a great dainty. The isthmus enjoys a bad celebrity for snakes and poisonous reptiles; but the observations of Mr Lloyd do not go to confirm this report. The country people, however, stand in great awe of them, and will seldom move abroad after nightfall, lest they should encounter them. They even go so far as to wear charms round their necks for the protection of their persons. A great pest in the country are what are called ganapatas, or ticks, which, in half an hour's walk in summer, will completely cover the person, and are with difficulty loosened from their hold. There are other smaller insects, very numerous and annoying, amongst which mosquitos are in the usual abundance. Fire-flies are common, and very brilliant; with many other insects, which Mr Lloyd apprehends have not yet found their way into entomological catalogues. Amongst the domestic animals, and those chiefly used for food, are oxen for draught and slaughter, horses, mules, goats, pigs, fowls, and fish. The breed of cattle is of a good size; and the draught-oxen, when well broken, fetch from twenty-five to thirty dollars each. The best of those for slaughter may be bought at from twelve to eighteen dollars each. The race of horses is small, but hardy, and their price varies from fifteen to forty dollars. Mules are the animals most prized in the country; for, as is well known, no other animal is ridden in mountainous districts. Their price sometimes reaches as high as 120 dollars; but they can be obtained for less money. Goats are not so plentiful as might have been expected; but as they are in great request in the West Indies, it is to be inferred that they are exported there whenever they attain the proper size, so that comparatively few on an average remain at Panama. Pigs are few, and of most exorbitant value. When of a good size, and well fattened, they fetch from thirty to thirty-five dollars each. Fish and fowl are plentiful, cheap, and much used; and in Panama market hundreds of young sharks, of the kind denominated shovel-nosed, and from one to two feet and a half long, are daily sold for food. The guana is considered an especial dainty, as are pearl oysters, and many varieties of game, which are brought in from the woods. Even the monkey tribes are eaten, especially in the country bivouacs, although they are seldom offered for sale in the town markets. The chief articles of farinaceous food are maize and rice; yet the home growth of either seems to be rather limited for so fine a region. The greater part of the sugar used in the isthmus is imported in skins from Central America, or from the valley of Cauca, by way of Buonaventura, on the Choco coast, and is consequently very dear. The home produce is chiefly miel or molasses, and raspadura or pan-sugar, which the inhabitants prefer to the finer preparations of the article. Great quantities of wild honey are gathered in the woods, the bees collecting which do not sting, and are thus robbed without precaution.

The communication across the isthmus is maintained chiefly by two lines of road; one from Panama to Portobello, and another equally from Panama, by way of Cruces, to Gorgona, down the Chagres, to the seaport of the same name at its mouth. There are some others in use, but little known, and under the Spaniards their improvement and multiplication were much discouraged. Mr Lloyd strongly recommends a new line to be formed, differing from them all, and beginning on the Atlantic at a fine bay called Limon or Navy Bay, about five leagues east from Chagres. From this he proposes it should proceed to the river Chagres, some miles above its mouth, where its course approaches this bay by a canal; thence up the river to a favourable situation on the south bank of the Trinidad, where its shores are excellently suited for being converted into wharfs and landing places, both for goods and cattle; and thence finally to Panama or Chorrera by a railroad, the latter being the shorter distance, but the former the preferable route, both as conducting to a better seaport, and as terminating in Panama, the capital and the centre of trade. Mr Lloyd's reasons for suggesting this innovation will be found detailed at length in the article to which we have already referred. The present roads are exceedingly bad, and they traverse a mountainous part of the country. That between Panama and Portobello is in this respect greatly the worse of the two, being in many places almost impassable in the rainy season, from the steepness of the ascents and descents. But the roads to Cruces and Gorgona also lead across a mountainous country, and are extremely difficult in bad weather; a considerable part of the latter, indeed, being merely the bed of what is in winter a large stream.

The isthmus of Panama is divided into two provinces, viz. Panama which includes the Darien, and Veragua. These again are divided into cantons, having a certain number of parishes in each. According to a census taken in 1822, the latest which we have been able to obtain, the following was the state of the population in the two provinces.

Province of Panama.—The canton of Panama, which comprehended eight parishes besides the capital, contained 16,724 souls; the canton of Chorrera, containing four parishes and the capital Chorrera, 7411 souls; the canton of Los Santos, containing eight parishes and the capital Los Santos, 21,348 souls; the canton of Nata, containing four parishes and the capital, 17,108 souls; the canton of Portobello, containing four parishes and the capital, 2425 souls; and the canton of Darien, containing seven parishes and the capital Tavisa, 1172 souls.

Province of Veragua.—The canton of Santiago, containing six parishes and the capital, 14,170 souls; the canton of Remedios, containing three parishes and the capital, 5010 souls; the canton de la Mesa, containing three parishes and the capital, 8722 souls; and the canton of Alange, containing six parishes and the capital, 7465 souls. The summary of the province of Panama gives the total number of inhabitants as 66,188, and that of Veragua as 35,367. The total population of the whole isthmus was 101,550 in the year 1822, nor has it altered to any great extent since. Most of these cantons, with the exception of Portobello and Darien, which are almost uncultivated, are alike in their resources; but distinct reports of the produce of each were not obtained by Mr Lloyd. The population is distributed into white and coloured; and most of the descendants of mestizoes, and even mulattoes, are considered as white, provided they be in easy circumstances. Wealth is here a powerful charm in dissolving caste. One person in every five has a house, or, in other words, the average number in a family is five. From the excess of births above deaths in one of the cantons, that of Los Santos, it appears that the rate of increase is one and a half per cent., which is low when compared with that of the United States, for instance, where the increase exceeds three and approaches four per cent. Of the houses, almost a half are marked as belonging to the country, which indicates at once security and the prevalence of agricultural occupations. Mr Lloyd thinks that the canton of Los Santos may be taken as a fair specimen of the others; with the exceptions already stated, and also that of Panama, the presence of the capital and the emporium of trade giving a preponderance in its favour. In general, however, the western and central districts, with the islands in the Bay of Panama, are the best cultivated and most populous, Los Santos being one of them. Elsewhere the landlords keep their estates chiefly in grass, to save trouble; and the population is nowhere industrious, although strong and enduring under occasional fatigue. The extreme fertility of the soil is one of the main causes of the general indolence; for with a small expenditure of labour, a man can procure a respectable subsistence for himself and family. They are, however, quite susceptible of steadily practising habits of industry when the stimulus employed is powerful enough to call forth their energies. "There are within the province," Mr Lloyd observes, "several regiments of militia, formed of the lower classes of people and Indians, excellent workmen in felling timber and clearing ground, and particularly apt in acquiring any mechanical art." They are exceedingly simple in their habits, and are easily maintained, so that, in the projected communication between the Pacific and Atlantic Oceans, workmen will be obtained at a cheap rate; a circumstance of very great importance to the success of the undertaking.

The capital of the isthmus is Panama, the site of which has been once changed. The old city stood about three miles east from the present situation; and, on the first arrival of the Spaniards in 1515, it was occupied by an Indian population, who were attracted to the spot on account of the vast abundance of fish on the coast, and gave the name of Panama to their place of residence, that word in their language signifying "much fish." The natives, however, were speedily dispossessed by their ruthless invaders; and, as early as the year 1521, the title and privileges of a city were conferred on the Spanish town by the Emperor Charles V. In the year 1670, old Panama was reduced to a heap of ruins by the pirate Morgan; and it was after this catastrophe that the city was built on the spot where it now stands. Panama is situated in latitude 8. 57. north, and longitude 79. 30. west from Greenwich, on a rocky tongue of land shaped nearly like a spear-head, extending a considerable way into the sea. Its harbour is protected by a number of islands lying at a little distance from the mainland, and some of which are of considerable size, and highly cultivated. These spots upon the sea, scattered around the Bay of Panama, are the gardens of the town, and afford a plentiful supply of fruit and vegetables. There is good anchorage under the lee of all of them; and, besides the productions of the soil, good water can be obtained from nearly the whole of them. The plan of the city is somewhat irregular; but the principal streets extend across the peninsula, which allows a current of air freely to circulate; and the rules for cleanliness are here more strictly observed than is usual in Spanish American towns. The fortifications which encircle the town are neither regular nor strong, although the walls are high, and the bastions have been constructed from time to time, as circumstances required that the place should be protected. The buildings are of stone, and generally most substantial, those of a large size having patios or courts. They are constructed in the old Spanish style. Amongst edifices of a public nature may be mentioned a beautiful cathedral, four convents, now nearly or altogether deserted, a nunnery, a college de la Compania, and also the walls of another, which was begun on a magnificent scale, but was never finished, and is now crumbling to ruins. Immediately around Panama, eastward along the coast, and north-westward from it, the land is low and flat; but westward and north-eastward, the mountains approach it closely; and, from a hill in the vicinity, about six hundred feet in height, a view may be obtained of the sea with its islands, and the country with its forest-mantled mountains, and its green savannahs. The beach is fringed with plantain and banana trees, growing amongst oranges, figs, and limes, and numberless rich shrubs, shaded by the tamarind, which crowns them all, except the cocoa-nut, with its feathery top and naked stem. Panama is celebrated for its gold chains, in the manufacture of which the natives are remarkably expert. The hat which goes by the name of this city, and is a favourite head-dress in the country, is brought from Guayaquil, and costs from two to twenty dollars. This city enjoyed a long period of prosperity; but it has materially declined since America cast off the Spanish yoke. Yet it possesses advantages in regard to situation which may yet be turned to great commercial account; and Panama may still be restored to more than its former opulence and splendour. The population amounts to nearly 11,000.

Portobello is situated in latitude 9. 34. 35. north, and longitude 77. 45. west, close to the sea, at the foot of immense mountains, which surround the whole of the port. It consists of one long street, which environs the bay, and from it smaller ones branch off where the ground renders this practicable. There are, besides, two squares, one in front of the treasury, which is built of stone; and another formed on one side by the church, which is also of stone, and a capacious edifice, considering the smallness of the population. It has been allowed, however, to fall into ruin; and the same may be said of all the public and most of the private buildings. The hospital, and even the fortifications, are dilapidated; and of the houses in town only a few remain tenantable. Portobello has an unhappy notoriety for the insalubrity of its climate, and has acquired the title of the Sepulchre of Europeans. The heat is most oppressive, and the town being closely environed by mountains, the freshness of the sea-breezes is never felt. Immense forests also cover the mountains, and the denseness of their foliage excluding the sun's rays, the earth remains moist, and a thick unhealthy vapour is continually exhaling, which collecting in clouds, covers the town like a pall, and keeps up an almost perpetual rain. Not only the human species, but even the lower animals, degenerate, and cease to produce in this Golgotha; so that not a cattle-estate is to be found in its vicinity, all the meat consumed being brought from Panama. The mountains and forests, which abound with animals of various kinds, extend to the very foundations of the houses, so that it is no uncommon thing to find wild hogs and

Panama.

small tigers usurping the abodes of man. Toads of a large size are also so abundant, that after a night of rain they cover the streets like a living pavement, and it is impossible to walk without crushing them. The population is now extremely limited, about eleven hundred; the greater part being negroes and mulattoes, with a few old Spaniards, tenacious of their property, and who are rapidly dying out. Occasionally a few visitors from Panama arrive with goods, which they dispose of at an exorbitant rate; and a small detachment of troops is sent from the capital to do duty for a short time.

Chagres is a miserable place, about thirty-two miles west from Portobello. It is situated in a little sandy bay, at the mouth of the river Chagres, on its north side, and consists of an assemblage of dirty, rude, ill-conditioned huts, built of reeds. From the nature of the surrounding country, it is open to no wind but a westerly one, and is thus, like Portobello, extremely unhealthy. A castle, in which ten guns are mounted, protects the mouth of the river and the small harbour. The inhabitants are chiefly black or coloured, with the exception of a few custom-house officers, and the commandant of the castle. They are said to amount to about two thousand in number. Chagres and Portobello are the only towns or villages on the Atlantic shore of the isthmus; and, as we have seen, they are of a very inferior description. About nine miles east from Chagres is Navy Bay, called also the Bay of Limon. It is large and spacious, being three miles in width at the entrance. The other towns of Panama are of little importance. Gatun is but a small village. Gorgona is somewhat larger, being a point where passengers going to the capital frequently land. Cruces, however, is the place to which goods are always conveyed. It is pleasantly situated on a fine open plain, upon the left or southern bank of the river Chagres, about thirty-four miles from its mouth, and eight hours' ride from Panama. The inhabitants of these places are nearly all owners of canoes or mules, or store-keepers for taking charge of goods, or bagas, that is, persons employed in working canoes. Cruces and Gorgona are also resorted to in summer as watering-places by the inhabitants of Panama, being considered very healthy; and the town of Chorrera, situated upon the river of that name, enjoys the same advantage.

The trade on the Atlantic shore of the isthmus is maintained with Jamaica by a British man-of-war, which sails monthly for the purpose of conveying letters and specie; with Carthagena by government vessels, twice a month; and with the same and a few other points by independent traders, which bring freight to Chagres, and there exchange it. On the Pacific side it embraces all parts of the coast, both north and south, which find it their interest to communicate with Europe in this way. Specie is conveyed across the isthmus to be embarked at Chagres at an expense of ten dollars two reals for every five thousand dollars or ounces; and there is, besides, a transit duty of three per cent. on silver, and one per cent. on gold. Return goods are brought to Panama, where they are lodged in the custom-house immediately on their arrival. If for exportation, they pay a duty of two per cent.; and if for home consumption, according to the nature of the article. The trade of the isthmus is very limited, but it is believed to be improving. The financial affairs of the government of Panama stood thus in 1827:—Receipts, 241,682 dollars; expenditure, 238,929 ditto; leaving a balance in the treasury of 2753 dollars. The income is not one third of what it was in 1812, when Panama was attached to Spain; but this arose from that exclusive system of dealing which was universally practised by that power.

The upper classes in the isthmus belong to the common stock of Spanish America, but are by no means so far advanced in civilization as their neighbours. The white people, and particularly the women, who are exceedingly retired in their manners, are noted for a tinge of the European complexion, which is scarcely to be looked for from their geographical position. They are very superstitious and illiterate, children being brought up in the very worst manner. Hence, although there is a well-conducted college at Panama, the blessings which it would otherwise diffuse are greatly counteracted by the negligence with which parents superintend their offspring, allowing them to associate indiscriminately with the lowest negroes of their own age. They thus acquire habits of gambling and other kinds of low vice; the first being the curse of the country, and indeed of almost every part of the former dominions of Spain in the western world. The inhabitants display a considerable turn for commerce; and, from the highest to the lowest, each keeps a shop or tienda. The lower classes also pursue different handicrafts; but, with the exception of goldsmiths' work, to which we have already alluded, they are rude in all. The field for this branch of art, however, as for every other which contributes to luxury, is now much curtailed. But the dress of the women, on occasions of religious processions or rejoicings, is still very splendid. They decorate their persons with a profusion of ornaments, amongst which pearls are conspicuous for their number and brilliancy. These are procured amongst the islands off the coast, by diving, which is pursued as a favourite occupation, although both very laborious and uncertain.

By the last arrangement affecting this country, it forms the north-western boundary of New Grenada, one of the three republics into which Colombia separated in the year 1832.

We are unwilling to enter at any length into the much agitated question of a communication between the Atlantic and Pacific Oceans, because it is at present only a matter of speculation, and, from all appearances, the work will be one of distant and very uncertain fulfilment. There are no less than five plans by which it is proposed to effect this junction. Beginning with the most northerly, it has been suggested that the Gulf of Mexico might be united to the Gulf of Tehuantepec in the Pacific, by means of a canal which should join the sources of the Chimilapa to those of the Rio del Passo. The distance (thirty-eight leagues), and other circumstances, render this plan by no means a favourite. Its realization is more important to the state of Mexico than to the general interests of the commercial world. By the second and third plans, the lines of communication pass through Central America, and a notice of them will be found in the article NICARAGUA. The communication through the Isthmus of Panama has occupied more attention than any of the others; and although it will not answer for a ship-canal, it presents great facilities for transferring merchandise from one ocean to the other, at a trifling expense, by a river and canal sufficiently deep for steam-boats. Mr Lloyd's attention was chiefly directed to the practicability of a railroad along the level country between the mouth of the Trinidad and the town or river of Chorrera; and no doubt this work would be very beneficial. But many persons are of opinion, that by deepening the Obispo, and the Mandingo, which flows into it, and then connecting these rivers by a canal with the Rio Grande, at the point whence it is navigable to the Pacific, the desired object would be attained fully as well as by the plan of Mr Llyod. The distance from the Chagres, at the point where the Obispo enters it, to the Rio Grande, is twelve miles; and the Obispo, at its junction with the Mandingo, or nearly at that part, approaches to within four miles and a half of the Rio Grande, the interval between the two rivers presenting no serious obstacle, and being nearly flat. This is certainly the shortest route; but whether it is practicable, or is even the best, remains to be determined by proper surveyors and engineers. Before individuals sent out in these capacities shall have examined the country and published their reports, no correct judgment can be formed upon the merits of the several plans. A question here arises, and it is one which ought to be deliberately discussed before anything is done in the matter, namely, should the communication be of that limited nature which would render it necessary for the goods to be transported by smaller craft or by railroads from one vessel in the Atlantic to another in the Pacific; or ought it to be a large ship-canal, capable of admitting vessels of deep draught, and thus effectually uniting the two oceans at once? Such a plan is said to be practicable at the isthmus of Cupica; and this is the last of the five which we mentioned as having been proposed. Humboldt, who is a great authority, is of opinion that Cupica Bay merits the serious attention of men of science, from the great facilities it presents for solving the problem of a ship-canal. The scheme is simply to connect Cupica Bay, in the Pacific, with the large river Atrato, flowing into the Atlantic, by forming a canal across the interval, which is ascertained to be a perfect level. The course of the river Naipi, before its confluence with the Atrato, intersects this level country within five leagues of the Bay of Cupica. The Atrato flows through the province of Choco, in which it rises, and reaches the Atlantic at the southern end of the Gulf of Darien, in the Bay of Choco.

One thing is certain, that were such a communication between the two great oceans effected, it would prove of incalculable utility to all nations engaged in maritime commerce, and sooner or later it will unquestionably be opened. Geographically, this would be nearly the shortest possible route from Europe, North America, a great part of Asia, as well as from Africa to every port on the western coast of the New World. With regard to the more obvious saving of space to be travelled over, we need say nothing; a glance at a map of the world will show at once what would be gained. Therefore, although only the smaller work were carried through, there would be an immense saving in time, by the greater certainty of good and safe passages in a voyage from Panama to Canton, Australia, and every port and island in the Pacific Ocean, notwithstanding the necessity for disembarkation and transhipment. But the advantages of a canal of sufficient size to allow large vessels to proceed right across the isthmus would be incomparably greater. They must, however, be so obvious to every mind, that we need not enlarge upon them in this place. But by whom is either of the two works to be accomplished? The question is not a British one alone, nor even an European; it is more particularly an American question, though the whole commercial world would be more or less remotely affected by it. It is not likely, therefore, that any individual nation will be so generous as to undertake the expense on its own account; and there must be either a joint-stock company of governments formed, who will agree to defray so much each of the expenditure, or a joint-stock company of individuals, who will accomplish some one line of communication or another, and indemnify themselves for their outlay by planting tolls upon it. (R. R. R.)

PANAMAO Isle, one of the Philippine Islands, about fifteen miles in circumference, and of a triangular form. Long. 124. 15. E. Lat. 11. 27. N.

PANAON, or Panahan, is one of the Philippine Islands, about forty-five miles in circumference. It is well watered by numerous streams that flow from the mountains. Long. 125. 12. E. Lat. 10. 7. N.

PANARAGA, a town of the island of Java, and capital of a kingdom, situated on the southern side of the island. It is sixty miles east of Mataran.

PANAROOCAN, a town of Java, in the north-eastern extremity of the island, situated on a river which enters the sea by several mouths. It was formerly the capital of an ancient principality, but is now subject to the Dutch. It has a square fort, built with palisades and planks, and which stands about three quarters of a mile from the sea, in a marshy plain. Long. 114. E. Lat. 7. 40. S.

PANATHENÆA, Παναθηναια, in Grecian antiquity, an ancient Athenian festival, in honour of Minerva the protectress of Athens. Harpocration and Suidas refer the institution of this festival to Erichthonius IV. king of Athens, who lived before Theseus. Theodoret alone says that the feast was established by Orpheus. But be this as it may, till the time of Theseus it was never a particular feast of the city of Athens, and was simply called *Athenæa;* that prince, however, having united all the people of Attica into one republic, they afterwards assisted at the festival; and hence the name *Panathenæa*, or the feast of all Attica. In effect, all Attica was present; and each division of the people sent a bullock for the sacrifices, and for the entertainment of the vast multitude of people assembled.

There were two festivals under this denomination; the greater and the lesser. The greater Panathenæa were exhibited every five years; the less, every three years, or, according to some writers, annually. Though the celebration of neither employed at first more than one day, yet in after times they were protracted for the space of many days, and solemnized with greater preparations and magnificence than at their first institution. The ceremonies were the same in the greater and the lesser Panathenæa; excepting a banner, on which the actions of the goddess were represented in embroidery, executed by maids, with the names of those who had distinguished themselves in the service of the republic. This only was borne at the greater. Prizes were established for three different kinds of combat. The first consisted of foot and horse races; the second, of athletic exercises; and the third, of poetical and musical contests. These last are said to have been instituted by Pericles. Singers of the first class, accompanied by performers on the flute and the cithara, exercised their talents upon subjects prescribed by the directors of these exhibitions.

PANAULON, an enlarged German-flute, with sixteen finger-keys, and descending as low as G in the treble clef, with two ledger lines under the stave. It was invented a few years ago by Trexler of Vienna. To remedy its inconvenient length, the lower end was curved. The quality of its tone is not so good as that of the common German-flute; but still the panaulon may be effectively used in orchestra music, as a bass to the other flutes.

PANCARPUS, in Roman antiquity, a kind of show which the Roman emperors frequently exhibited to the people. The word is formed from the Greek παν, *all*, and καρπος, *fruit;* and hence the name was also given by the Athenians to a sacrifice, in which all kinds of fruits were offered. In this spectacle, the circus being all set over with large trees, represented a forest, into which the beasts being admitted from the dens under ground, the people, at a sign given by the emperor, pursued, shot, and killed all they could lay hold of, which they afterwards carried away to regale upon at home. The beasts usually given on these occasions were boars, deer, oxen, and sheep.

Casaubon, Cujas, Pithon, and others, represent the *pancarpus* and *sylva* as the same thing; but Salmasius thinks they were different. The *sylva*, according to him, was such a diversion as that above described; but the *pancarpus* was a combat in which robust people, hired for that purpose, fought with wild beasts. This opinion Casaubon confirms from Cassian, Justinian, Claudian, Firmicus, Manilius, and Cassiodorus.

PANCHBERARAH, a town of Hindustan, and small district, in the province of Cashmere. Long. 75. E. Lat. 34. 32. N.

PANCO POINT, a remarkable cape, situated at the north-eastern extremity of the island of Java, at the mouth of the western entrance of the Straits of Madura. Here are stationed Javanese and European pilots, who, as soon as vessels are seen standing for the channel, go before to pilot them to Gressee and Sourabaya. Long. 112. 44. E. Lat. 6. 48. S.

PANCRAS, a large parish formerly detached from the metropolis by wide and open fields, but now a great portion of the northern side of London. Within the last forty years it has been covered with large houses, composing some of the handsomest squares, and the widest and most uniformly built streets. The parish is very extensive, including a third of Highgate, the several hamlets of Battle-Bridge, Kentish Town, Somers Town, Cambden Town, and Tottenham Court Road, as far as Rathbone Place. The houses in the newly-built portion are not generally large, and many of them are small but neat; and as the rent is lower than in many other parts of the western portion of London, they are occupied by people of inferior wealth. Those houses which are of the superior kind are found, from their vicinity to the inns of court and the courts of law, to be appropriately adapted for persons in some way or other connected with the law, though many of them are filled by the families of mercantile men from the city. The old parish church is small, and still retains somewhat of its rural appearance. It is remarkable as the favourite burying-place of the Roman Catholics, and a very large proportion of the grave-stones exhibit a cross and the letters R. I. P., *requiescat in pace*, or, may he rest in peace. Two new churches have recently been erected, one of which, on the new road, is made the parish church, and is amongst the most magnificent of those new edifices. The growth of the parish may be seen from the population returns, thus: In 1801 the inhabitants amounted to 31,779, in 1811 to 46,333, in 1821 to 71,838, and in 1831 to 103,548.

PANCRATIUM (compounded of *παν, all*, and *κρατιω, I overcome*), amongst the ancients, a kind of intermixed exercise, consisting of wrestling and boxing; but it differs in this, that as the athletæ were not to seize the body, their hands were not armed with gauntlets, and gave less dangerous blows.

The *pancratium* was the third gymnastic exercise, and was not introduced till long after the others. The people who were engaged in these exercises were called *pancratiastæ;* a name which was also given to such as did not confine themselves to one exercise, but succeeded in several different ones.

PANCSOVA, a city of Hungary, in the province of the Hungarian frontier, the capital of the limits or circle of the German Banat regiment, which extends over 1656 square miles, comprehending the city and sixty villages, with 101,200 inhabitants. The city is situated upon an arm of the Themes, at its influx into the Danube. It contains 960 houses, and 8640 inhabitants, who carry on considerable commerce with their Turkish neighbours. Long. 20. 32. 2. E. Lat. 44. 49. 40. N.

PANDA, in *Mythology*, a goddess who was invoked and honoured as the protectress of travellers and navigators. The goddess of peace was also called Pandar, because she opened the gates of cities which were shut in time of war. According to Varro, Panda is a surname of Ceres, formed *a pane dando*, because she gave bread to mankind.

PANDAR, a small town of Hindustan, in the Sikh territory, and province of Lahore, 132 miles north-east from the city of Lahore. Long. 75. 16. E. Lat. 33. 17. N.

PANDECTS, PANDECTÆ, in jurisprudence, the digest or collection, made by Justinian's order, of 534 decisions or judgments of the ancient lawyers, on as many questions occurring in the civil law; to all which that emperor gave the force and authority of law, by the epistle prefixed to the collection. The word is Greek, Πανδεκται, being compounded of *παν, all*, and *δεχομαι, I take;* that is, a compilation, or a book containing everything relative to public and private rights. Others, however, as Bartoli, think it was formed from *παν*, and *δεχομαι*, because these books were supposed to contain the whole doctrine of the civil law. See the article CIVIL LAW.

PANDICULATION is that violent and extensive motion of the solids which usually accompanies the act of yawning.

PANDIWORA, a village of Hindustan, in the province of Gujerat, near to which flows a stream of clear but salt water.

PANDORA, in fabulous history, a woman formed by Prometheus, to whom each of the gods gave some perfection. Venus bestowed upon her beauty; Pallas, wisdom; Juno, riches; Apollo, music; and Mercury, eloquence. But Jupiter being displeased at Prometheus for having stolen fire from heaven to animate the mass he had formed, gave Pandora a box, which she was enjoined not to open; and then sent her to the earth with this box, in which were enclosed age, disease, pestilence, war, famine, envy, discord, and all the evils and vices that could afflict mankind. This fatal box was opened by Epimetheus, brother of Prometheus, when instantly all the diseases and mischiefs with which it was filled spread over the earth, and Hope only remained at the bottom. Hesiod says Pandora was the first woman.

PANDORA, a small kind of lute, with fewer strings than the ordinary lute. It is believed to have originated in the Ukraine, where it is used to accompany vocal music, or to play national and Polish dances. Some writers are of opinion that this instrument was known to the ancient Egyptians, and that amongst them it had three strings.

PANDURA, a Neapolitan instrument, of a larger size than the mandola, and strung with eight metal wires. It is played with a quill. The pandurina was an instrument of a similar kind, with four strings, but is now disused.

PANEGYRIC, an oration in praise of some extraordinary person or virtue. The name is Greek, *πανηγυρις*, being composed of *παν, all*, and *ἀγειρω, I assemble;* because anciently in public and solemn assemblies of the Greeks, either at their games, feasts, fairs, or religious meetings, panegyrics were pronounced. To render these the more solemn, the Greeks used to begin with the praises of the deity in whose honour the games were celebrated; next they descended to the praise of the people or country where they were celebrated; then they lauded the princes or magistrates who presided at them; and, lastly, they bestowed eulogies on the champions, especially the conquerors, who had gained the prizes in them.

PANEGYRICUM, in church history, an ecclesiastical book, used by the Greek church, containing the panegyrical orations of various authors, on the solemnities of Jesus Christ and the saints. It is found in manuscript in most churches, but it is not the same in all, each church having its particular saints; indeed the compilers of this kind of books usually suited their collections to the taste of their own devotion. They are disposed according to the order of the months, and frequently consist of twelve volumes, answering to the twelve months of the year. Amongst the principal authors of this work are Athanasius, Cyril, Basil, Chrysostom, and others.

PANEL (*panella, panellum*), according to Sir Edward Coke, denotes "a little part;" but the learned Spelman says that it signifies *schedula vel pagina*, a schedule or roll, as a panel of parchment, or a counterpane of an inroll, as a panel of parchment, or a counterpane of an indenture; but it is used more particularly for a schedule or roll, containing the names of such jurors as the sheriff returns to pass upon any trial. Hence the *impanelling* a jury is the entering their names in a panel or little schedule of parchment.

PANELA, or PANNELA, a town and fortress of Hindustan, in the province of Bejapore. It is one of the strongest fortresses in India, which was taken by the celebrated Mahratta chief Sevajee, by stratagem, in the year 1660. It was subsequently besieged in vain by the army of the king of Bejapore; and yielded to the powerful arms of Aurungzebe about the year 1670. It was near this place that the British ambassador, Sir W. Norris, had his audience of Aurungzebe in 1701. Long. 74. 20. E. Lat. 17. N.

PANGANSANE ISLE, an island in the Eastern Seas, situated off the south-eastern extremity of Celebes, fifty-two miles in length by sixteen in average breadth. It is low, level, and covered with fine trees.

PANGOOTARRAN, one of the Sooloo Archipelago Isles, in the Eastern Seas, about ten miles in length by four in average breadth. It is one entire bed of coral rock, with scarcely any appearance of soil on it. It abounds, however, in cocoa-nut trees, and has also plenty of cattle, goats, and fowls. Long. 120. 30. E. Lat. 6. 9. N.

PANHA, a village of Hindustan, tributary to the Nepaul rajahs, in the province of Serinagur. It contains forty or fifty huts. Long. 79. 10. E. Lat. 30. 18. N. About six miles to the south of this place are the copper mines of Dhanpoor, and eight miles to the north those of Nagpoor.

PANIANY, a seaport town of the south of India, in the province of Malabar. It is situated on the south bank of the Palicaud River. It consists of about 500 houses belonging to traders, and 1000 huts inhabited by the lower classes of people, and forty mosques. It is very irregularly built; many of the houses are two stories high, built of stone, and thatched with cocoa-nut leaves. The houses are scattered over a wide extent of sandy plain; the river, though wide, has a bar at its mouth, which only admits the entrance of boats. The inhabitants are generally of the class of Mahommedans called Moplays. They were formerly very rich, and possessed vessels that sailed to Surat, Mocha, Madras, and Bengal. But they were reduced to great poverty by the oppressions of Tippoo Sultan. The exports from Paniany are teak timber, pepper, rice, corn, and cocoa-nuts. The chief imports are wheat, pulse, sugar, spices, &c. Paniany was taken possession of by the British troops under Colonel Humbertson in 1782. It was afterwards recovered by Tippoo, with whom it remained till the conclusion of peace in 1792, when, with the province of Malabar, it was annexed to the British possessions. It is forty miles south by east from Calicut. Long. 76. E. Lat. 10. 44. N.

PANIC denotes an ill-grounded terror or fright. Polyænus says it originated from Pan, one of the captains of Bacchus, who with a few men put a numerous enemy to route, by a noise which his soldiers raised in a rocky valley, favoured with a great number of echoes. This stratagem making their number appear far greater than it was, the enemy quitted a commodious encampment, and fled. Hence all ill-grounded fears have been called *panics*, or *panic fears;* and it was this that gave occasion to the fable of the nymph Echo being beloved by the god Pan. Others derive it from the circumstance, that in the wars of the Titans against the gods, Pan was the first who struck terror into the hearts of the giants. Theon on Aratus says he did it by the means of a sea-shell, which served him for a trumpet.

PANIONIA, in *Antiquity*, a festival celebrated in honour of Neptune, by a concourse of people from all the cities of Ionia. In this festival, if the bull offered in sacrifice happened to bellow, it was accounted an omen of divine favour, because that sound was thought to be acceptable to Neptune.

PANMELODICON, an instrument invented by Leppich at Vienna in 1810. By means of a conical barrel moved by a wheel, rods of metal, bent to a right angle, were made to sound when the finger-keys were pressed down.

PANNAH, a town of Hindustan, in the province of Allahabad, and district of Bundelcund, celebrated for the diamond mines in its neighbourhood, which, during the reign of Akbar, produced L.100,000 a year. It is thirty miles south-east from Chatterpore. Long. 80. 17. E. Lat. 24. 43. N.

PANNARIA, one of the group of the Lipari Islands, in the Mediterranean Sea. It was called Thermissia by the ancients, on account of its natural warm baths. It is about seven miles in circumference, and contains 200 inhabitants, who cultivate a rich volcanic soil. There is a good port on the south side for small vessels, called Calla de Castello.

PANNIPUT, a town of Hindustan, in the province of Delhi. It is about four miles in circumference, and was formerly surrounded with a brick wall, which partly remains. In the centre of the town is the shrine of a Mahommedan saint, who flourished during the fourteenth century. The surrounding district is fertile in sugar, and a considerable trade is carried on by the town in that article, and in salt and grain. It is celebrated as the scene of two of the greatest battles ever recorded in the history of Hindustan. The first was in the year 1525, between the army of Sultan Baber and that of the Delhi Patan Ibrahim Lodi, in which the latter was defeated and slain. The second, which was still a greater and more decisive action, took place between the combined Mahommedan army, commanded by Ahmed Shah Abdalli, king of the Afghans, consisting of 80,000 cavalry and infantry, and eighty pieces of cannon, and that of the Mahrattas, commanded by Bhow Sedasiva, nephew of the peishwa, who had under him about 70,000 regulars, with 15,000 Pindarries, and nearly 200 pieces of cannon. The Mahrattas were completely overthrown, and the whole host nearly destroyed; so that they were never able again to contend with any hope of success for the dominion of India. It is fifty miles north by west from the city of Delhi. Long. 75. 50. E. Lat. 29. 23. N.

PANORAMA. A panorama is a picture drawn on the interior surface of a large cylinder, representing the objects that can be seen from one station, when the observer directs his eye successively to every point of the horizon. A picture drawn on a vertical plane in the usual way includes only that portion of the sphere of vision that can be seen from one point opposite to the picture, without turning the eye; this portion may comprehend about thirty degrees of the horizon, because the field of distinct vision when the eye remains unmoved is concluded in a cone the angle at the apex of which does not exceed thirty degrees. There are compositions comprehending the visible hemisphere, and sometimes nearly the whole sphere of vision; and in these, one connected scene is represented on the interior surfaces of a polyhedron, or of a curved solid, the point of sight being in the centre of the polyhedron, and the eye being turned round on its centre, to each of its surfaces, in order to view the whole scene. Of this kind are the gnomonic projection of the sphere on the interior surfaces of a cube, and several pictures, in which one connected subject is represented on the ceiling and the sides of a room; such as the picture of Jupiter fulminating the giants, by Julio Romano, on the walls and hemispherical ceiling of a round room in the Palazzo del T, at Mantua; and the architectural representations and ornaments in Raffaelle's Loggia in the Vatican. Objects are also sometimes projected on the interior surface of a sphere, the eye being placed in the centre; as in a large hollow sphere with the constellations, which was constructed at

Pembroke College, Cambridge. These projections, where the eye, remaining in the point of sight, is turned round on its centre to view the different parts of the picture, are formed on the same principle as the panorama.

The cylindrical surface is the most convenient for panoramas of landscapes; and the specific employment of a large cylindrical surface for representing the landscape of the whole circle of the horizon, is the invention of Mr Barker, who brought the panorama into use, and still continues to exercise his art. The cylinder on which the panorama is painted is commonly about sixty feet in diameter. The projection or perspective of a panorama is formed by imaginary lines drawn from different points of the surrounding objects, to the point of sight in the axis of the cylinder. The intersections of these lines with the cylindrical surface form the corresponding points in the panoramic picture. Where the picture is projected on a plane, as in common perspective, and in the gnomonic projection of the sphere, the cones formed by imaginary lines or rays passing from the point of sight to the different objects are cut by the plane of the picture; consequently, the sections being formed by a plane, are curves, of which the curvature is always simple. In the perspective of the panorama, where the picture consists of the intersection of the cones of rays by a cylinder, these intersections are, in many of the cases, doubly curved curves. When the picture of a straight line, which is neither parallel to the horizon nor to the axis of the cylinder, is drawn on the cylinder of the panorama, the picture of the line is part of an ellipse, because the oblique section of a right cylinder, by a plane passing through the axis, is an ellipse; when the cylinder is developed and unrolled on a plane surface, this ellipse becomes the curve called the sinical curve. The projection of lines on the interior surface of a cylinder is also employed in drawing Mercator's charts. But in the projection of the panorama, the field extends only a few degrees above and below the horizon, whereas, in the projections of the sphere, the field extends many degrees on each side of the plane, which is at right angles to the axis of the cylinder. In drawing a panorama, as well as in drawing a picture on a plane, the horizontal angles between different objects may be observed by a plane table or theodolite; and the elevation of the objects above the horizon, or their depression, may also be observed by the theodolite. The horizontal angles are to be laid down by setting off on the graduated horizon of the cylindrical picture the number of the degrees observed; the vertical angles on the cylinder are the tangents of the angles observed, the radius being the semidiameter of the cylinder. (B. B.)

PANORMO, a town of Asiatic Turkey, in Anatolia, on the south coast of the Sea of Marmora. It is sixteen miles south-east of Artaki.

PANOU, a river of Asiatic Russia, which falls into the Niznei Tunguska. Long. 102. 24. E. Lat. 64. 40. N.

PANTÆNUS, a Stoic philosopher, born in Sicily about the beginning of the reign of Commodus. He presided over the celebrated school of Alexandria, where, from the time of St Mark, the founder of that church, they had always a divine who was eminent for his learning and piety to explain the Holy Scriptures, and to instruct them in human learning. This employment he was obliged to leave; for when the Indians required of Demetrius, bishop of Alexandria, to send them one to instruct them in Christianity, he sent Pantænus, who undertook the mission with joy, and behaved himself very properly in it. It is said that the Indians had been tinctured with Christianity by St Bartholomew the apostle; and that Pantænus met with the Hebrew original of St Matthew's gospel, which the apostle had left there. St Jerome says that Pantænus brought it with him, and that in his time it was preserved in the library of Alexandria. But we suspect that St Jerome is mistaken in this respect. When Pantænus returned to Alexandria he re-assumed the government of the school of that city, which he had probably during his absence committed to the care of St Clement, a presbyter of Alexandria. He explained the Scriptures publicly, under the reign of Severus Antoninus Caracalla, and, in St Jerome's opinion, was more serviceable to the church by his discourses than by his writings. He published some commentaries upon the Bible, which are lost. That the prophets often express themselves in indifferent terms, and that they make use of the present time instead of the past and future, is a rule of Pantænus, which has been followed by all succeeding interpreters. Theodorus has related this rule; but he speaks of it as if Pantænus had rather said than written it. We may have some notion of Pantænus's manner of explaining the Scriptures by the similar performances of St Clement of Alexandria, Origen, and others who were brought up in that school.

PANTALONE, an instrument invented about the end of the seventeenth century, by Hebenstreit, a German. It resembled the German psaltery, was of an oblong shape, and had two sound-boards, the one furnished with metal wires, the other with gut-strings. Its compass was the same as that of the harpsichord.

PANTALOON, a sort of garment consisting of breeches and stockings of one piece, and said to have been first introduced by the Venetians.

Pantaloon, in the theatre, is a buffoon or masked person, who performs high and grotesque dances, and shows violent and extravagant postures and airs. The word is likewise used for the habit or dress which these buffoons usually wear, and which is made precisely to fit the body, being all of a piece from head to foot.

PANTELLARIA, an island in the Mediterranean Sea, belonging to the kingdom of Naples, between Sicily and Cape Bon in Africa, seventy-two miles south of Maritimo. It is about thirty miles in circumference, and is entirely volcanic, consisting of vestiges of lava, pumice, scoriæ, and puzzolana. The interior consists of hills covered with brush-wood, and valleys well cultivated with vines, cotton, and fruit, especially raisins, but not yielding corn sufficient for the inhabitants. The capital is Oppedulun, a large but very poor place. It has a haven, defended towards the sea by a castle and another battery, and is convenient for small vessels, who load with wine, oil, cotton, archil, raisins, and some alum. The population of the island is 4600 persons, tolerably active, but of lax morality, many being fugitives from the law in other parts of the Neapolitan dominions. Near Sataria Point are some grottos, called stoves, which emit vapours deemed efficacious in the cure of some diseases. Long. 11. 54. 20. E. Lat. 36. 51. 15. N.

PANTHEA, in *Antiquity*, were single statues, composed of the figures or symbols of several different divinities. Joubert, who calls them *pantheæ*, and has remarked them sometimes on medals, says that their heads were most commonly adorned with the symbols or attributes belonging to several gods. An instance of this appears in a medal of Antoninus Pius, representing Serapis by the bushel, the Sun by the crown of rays, Jupiter Ammon by the ram's horns, Pluto by the large beard, and Æsculapius by the serpent twisted in his hand. Baudelot, in his dissertation on the Lares, observes, that the *panthea* had their origin from the superstition of those who, taking several gods for the protectors of their houses, united them all in the same statue, by adorning it with the several symbols proper to each of these deities.

PANTHEISM, a philosophical species of idolatry, leading to atheism, in which the universe was considered as the supreme God. The inventor of this absurd system is not known; but it was of early origin, and variously moditheon. fied by different philosophers. Some held that the universe was one immense animal, of which the incorporeal soul was properly God, and the heavens and earth the body of that God; whilst others held but one substance, partly active and partly passive, and therefore looked upon the visible universe as the only *Numen*. The earliest Grecian Pantheist of whom we read was Orpheus, who called the world the body of God, and its several parts his members, making the whole universe one divine animal. According to Cudworth, Orpheus and his followers believed in the immaterial soul of the world; therein agreeing with Aristotle, who certainly held that God and matter are coeternal, and that there is some such union between them as subsists between the souls and bodies of men.

In the ancient Orphic theology, we are taught that this universe, and all things belonging to it, were made within God, that all things are contained together in the womb of God; that God is the head and middle of all things; that he is the basis of the earth and heaven; that he is the depth of the sea, the air we breathe, the force of the untameable fire; that he is the sun, moon, and stars; and that there is one divine body, for,

Παντα γαρ ἐν μεγαλω τῳ δε σωματι κειται,

"all these things lie in the great body of God." But, further, to prove that the most ancient Greek philosophers resolved all things into God, and made God *all*, το παν, we shall cite a most remarkable passage from Plutarch's Defect of Oracles. "Whereas there are two causes of all generations, the divine and the human, the most ancient theologists and poets attended only to the more excellent of these two; resolving all things into God, and pronouncing this of them universally:

Ζευς ἀρχη, Ζευς μεσσα, Διος δ' ἐκ παντα τελονται,

'that God is both the beginning and middle, and that all things are out of God;' insomuch, that they had no regard at all to the other natural and necessary causes of things; but, on the contrary, their juniors, who were called naturalists, deviating from this most excellent and divine principle, placed all in bodies their passions, collisions, mutations, and commixtures."

That by the most ancient theologists here mentioned, Plutarch meant Orpheus and his immediate followers, is plain from the Orphic verse by which he proves their antiquity. By their juniors, whom he calls naturalists, he could mean no other than the first Grecian philosophers, Anaximander, Anaximenes, and Hippo, who were followed by the atheistical atomists, Leucippus, Democritus, Protagoras, and Epicurus. But with respect to the universe being God, and all things, divine and human, being modifications of mere matter, the Stoics undoubtedly agreed with Anaximander and his followers; for the school of Zeno held but one substance. This impious doctrine, that all things are God, and that there is but one substance, was revived in modern times by Spinoza, an apostate Jew. See Spinoza.

PANTHEON, a beautiful edifice at Rome, anciently a temple, dedicated to all the gods, but now converted into a church, and dedicated to the Virgin and all the martyrs. (See Rome.)

This edifice is generally thought to have been built by Agrippa, son-in-law to Augustus, from an inscription on the frieze of the portico. Several antiquaries and artists, however, have supposed that the Pantheon existed in the times of the commonwealth, and that it was only embellished by Agrippa, who added the portico. But be this as it may, the Pantheon, when perfected by Agrippa, was an exceedingly magnificent building; the form of the body being round or cylindrical, and its roof or dome spherical. Within, it is 144 feet in diameter; and the height from the pavement to the grand aperture on the top, through which it receives the light, is just as much. It is of the Corinthian order. The inner circumference is divided into seven grand niches, wrought in the thickness of the wall, six of which are flat at the top; but the seventh, opposite to the entrance, is arched. Before each niche are two columns of antique yellow marble, fluted, and of one entire block, making in all fourteen, the finest in Rome. The whole wall of the temple, as high as the grand cornice inclusive, is cased with different sorts of precious marble in compartments; and the frieze is entirely of porphyry. Above the grand cornice arises an attic, in which were wrought, at equal distances, fourteen oblong square niches; between each niche there were four marble pilasters, and between the pilasters marble tables of various kinds. This attic had a complete entablature; but the cornice projected less than that of the grand order below. Immediately from the cornice springs the spherical roof, divided by bands which cross each other like the meridians and parallels of an artificial terrestrial globe. The spaces between the bands decrease in size as they approach the top of the roof; to which, however, they do not reach, there being a considerable plain space between them and the great opening. That so bold a roof might be as light as possible, the architect formed the substance of the spaces between the bands of nothing but lime and pumice-stones. The walls below were decorated with lead and brass, and works of carved silver; and the roof was covered on the outside with plates of gilded bronze. There was an ascent from the springing of the roof to the very summit, by a flight of seven stairs; and, if certaina uthors may be credited, these stairs were ornamented with pedestrian statues ranged as an amphitheatre. This notion was founded on a passage of Pliny, who says that Diogenes the sculptor decorated the Pantheon of Agrippa with elegant statues, yet that it was difficult to judge of their merit, upon account of their elevated situation. The portico is composed of sixteen columns of granite, four feet in diameter, eight of which stand in front, with an equal intercolumniation all along, contrary to the rule of Vitruvius, who is for having the space answering to the door of a temple wider than the rest. On these columns there is a pediment, the tympanum of which was ornamented with bas-reliefs in brass; and the cross beams which formed the ceiling of the portico were covered with the same metal, as were also the doors. The ascent up to the portico was by eight or nine steps.

Pantheon.

In the reign of Tiberius, the Pantheon was considerably damaged; but it was repaired by Domitian, from which circumstance some writers consider him as the founder of the building. The Emperor Hadrian also did something to the edifice. But the Pantheon was more indebted to Septimius Severus, than to any one besides. The most, perhaps, that any of his predecessors had done, was adding some ornament to it; Septimius bestowed upon it essential reparations.

This temple subsisted in all its grandeur till the incursion of Alaric in the time of Honorius. Zozymus relates, that the Romans having engaged to furnish this barbarian prince with three thousand pounds weight of gold and five thousand pounds weight of silver, upon condition that he should depart from their walls; and having found it impossible to raise those sums either out of the public treasury or by private contribution, they were obliged to strip the temples of their statues and ornaments of gold and silver. It is probable that the Pantheon supplied a good part, as that of Jupiter Capitolinus was the only one in Rome that could vie with it in riches. Alaric carried off nothing from the Romans besides their precious metals. But, thirty-nine years thereafter, Genseric king of the Vandals took away part of the marbles; and whether from greed of plunder, or from a relish for the productions of art, he loaded

Pantheon.

one of his ships with statues. It cannot be questioned that on this occasion the Pantheon was stripped of more of its ornaments, and that the inestimable works of Diogenes became the prey of this barbarian.

Before these predatory visits of the Goths and Vandals, the Christian emperors had issued edicts for demolishing the Pagan temples. But the Romans, whatever were their motives, spared the Pantheon, which is known to have suffered no damage from the zeal of the pontiffs, or the indignation of the saints, before the first siege of Rome by Alaric. It continued so rich till about the year 655, as to excite the avarice of Constantius II., who came from Constantinople to pillage the Pantheon, and executed his purpose so far as to strip it both of its interior and exterior coverings of bronze, which he transported to Syracuse, where they soon afterwards fell into the hands of the Saracens.

About fifty years before this, Boniface IV. had obtained the Pantheon of the Emperor Phocas, in order to convert it into a church. The artists of those days were totally ignorant of the excellence of the Greek and Roman architecture, and spoiled every thing they laid their hands upon. To this period are to be referred certain alterations, of which we shall immediately have occasion to speak.

After the devastations of the barbarians, Rome was contracted within a narrow compass. The seven hills were abandoned; and the Campus Martius, being an even plain, and near the Tiber, became the ground-plat of the whole city. The Pantheon happening to stand at the entrance of the Campus Martius, was presently surrounded with houses, which spoiled the fine prospect; and it was still more deplorably disgraced by some of them which stood close to its walls.

From the time when Constantius carried off the brass plating of the exterior roof, that part was exposed to the injuries of the weather, or at best was but slightly tiled in, till Benedict II. covered it with lead, which Nicholas V. renewed in a better style. It does not appear that from this time till that of Urban VIII. any thing remarkable was done for the Pantheon.

Raffaelle, who had no equal as a painter, and who was also an architect, left a considerable sum by his will for the reparation of the Pantheon, where his tomb is placed; and Perino de la Vagua, Jacomo Udino, Annibale Caracci, Flamingo Vacca, and the celebrated Corelli, did the same. All the ornaments within which have any claim to be called good, are of later times. The paintings merit esteem; and the statues, although not masterpieces, do honour to sculpture, which alone is a proof that they are posterior to the fifteenth century.

Pantheon.

But, with all the respect due to a pontiff who was otherwise a protector and friend of the arts, it were much to be wished that Urban VIII. had never known that the Pantheon existed. The inscriptions cut at the side of the door inform us that he repaired it; yet, whilst he built up with one hand, he pulled down with the other. He caused two belfries constructed in a wretched taste to be erected on the ancient front-work, and he divested the portico of all the remains of its ancient grandeur, namely, the brazen covering of the cross beams, which amounted to such a prodigious quantity, that not only the vast canopy of the confessional of St Peter's was cast out of it, but likewise a great number of cannon for the castle of St Angelo.

Alexander VII. did what Urban VIII. had neglected to do. Whilst Bernini was constructing the colonnade of St Peter, this pontiff ordered search to be made for pillars to match those of the portico of the Pantheon; and some were found not far from the French church of St Louis, which were of the very same model. They were granite of the isle of Ilva or Elba, and those of the portico were Egyptian granite; the colour, however, was the same, so that the effect was equal. Nor did the pontiff's zeal stop here. He caused all the old houses before the portico to be pulled down, and the soil and rubbish which covered the steps, and even the bases of some of the pillars, to be cleared away. He began covering the roof with marble, and raised a lantern over the aperture, to keep out rain; but death removed him before his project was completed. Clement IX. his successor, enclosed the portico within iron rails. Several later popes have added to its decorations, which were all in the taste of the times when they were executed; and the body of the edifice and its architecture gained nothing by them. The main object of the liberality of the pontiffs was the embellishment of the grand altar. One sent purple curtains, another bestowed silver tabernacles, and others gave vases and superb dresses, suited to the solemn ceremonies of religion. All these might be called rich; but they had in no sense a tendency to retrieve the ancient majesty or original splendour of the temple. The true gusto of the ornaments was a little imitated at the revival of the arts. Good statues replaced the skeletons and squat figures which had disgraced the altars for the space of eight centuries. The paintings of Perugino and others covered the dull mosaics with which the Greeks of Constantinople had loaded the walls of most of the churches in Rome. The porphyry and the green and yellow antique found amongst the old ruins were likewise employed to much advantage.

PANTIKU, a village of Asiatic Turkey, on the north-eastern coast of the sea of Marmora.

END OF VOLUME SIXTEENTH.

Printed by Thomas Allan & Co.,
and Balfour & Jack,
and Stereotyped by Thomas Allan & Co.

Fig. 1.

ELEVATION OF A LOCK WITH SINGLE GATES.

Fig. 2.

PLAN OF LOCK WITH SINGLE GATES.

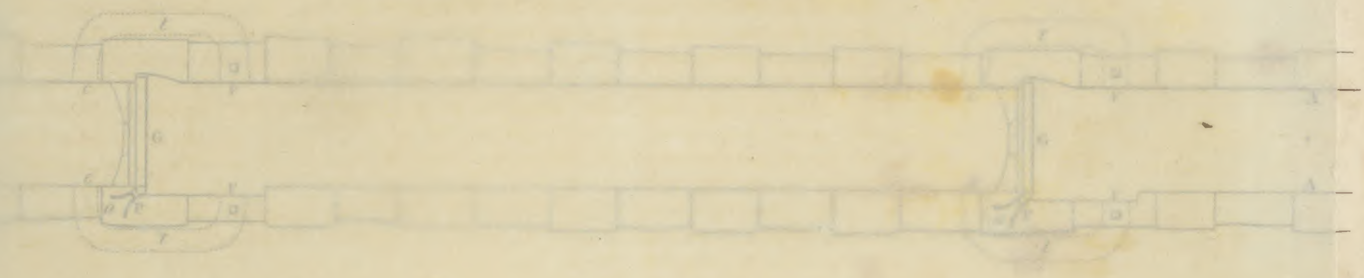

Fig. 3.

PLAN OF A TIDE LOCK.

Fig. 5.

SECTION.

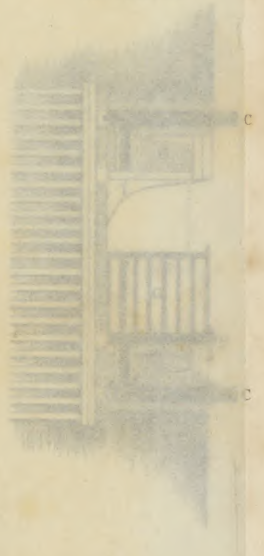

Fig. 4.

ELEVATION OF TIDE LOCK.

Geo. Aikman, Sculpt.

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END OF VOLUME SIXTEENTH.

Printed by T[illegible]
and Ra[illegible]
and Stereotyped by [illegible]

Fig. 1.

ELEVATION OF A LOCK WITH SINGLE GATES.

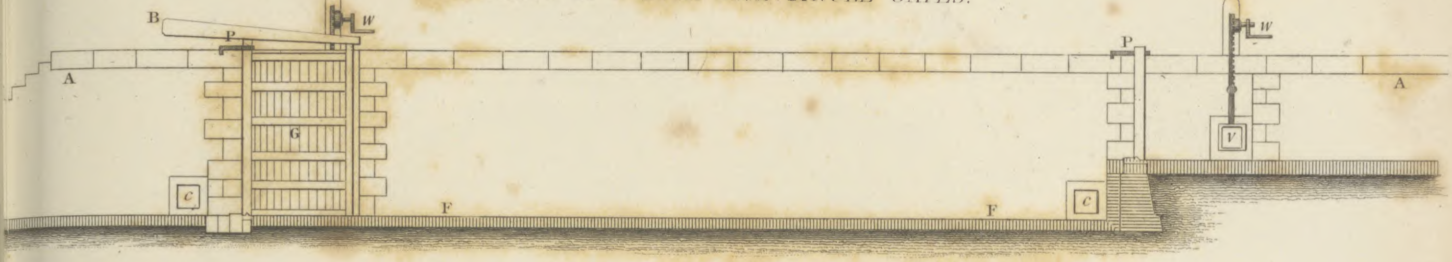


Fig. 2.

PLAN OF LOCK WITH SINGLE GATES.

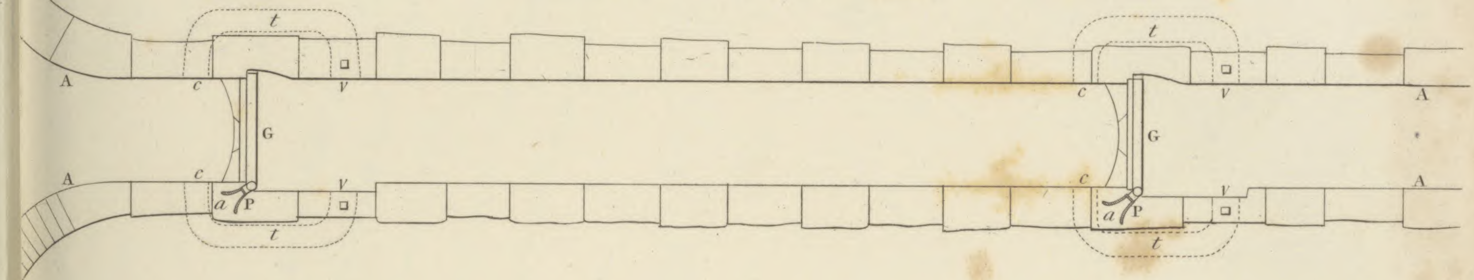


Fig. 3.

PLAN OF A TIDE LOCK.

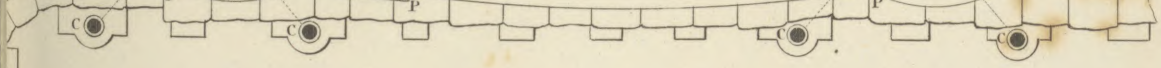


Fig. 5.

SECTION.

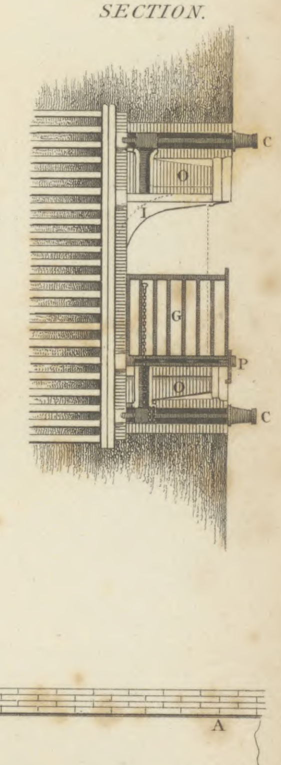
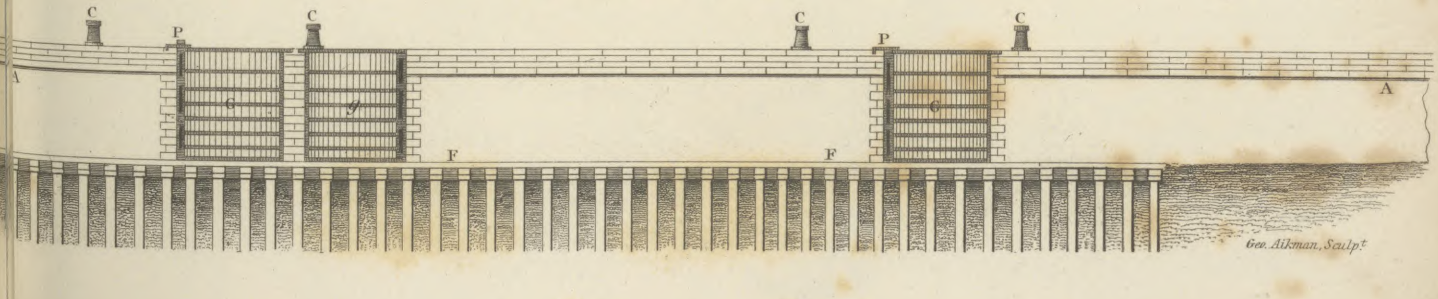


Fig. 4.

ELEVATION OF TIDE LOCK.



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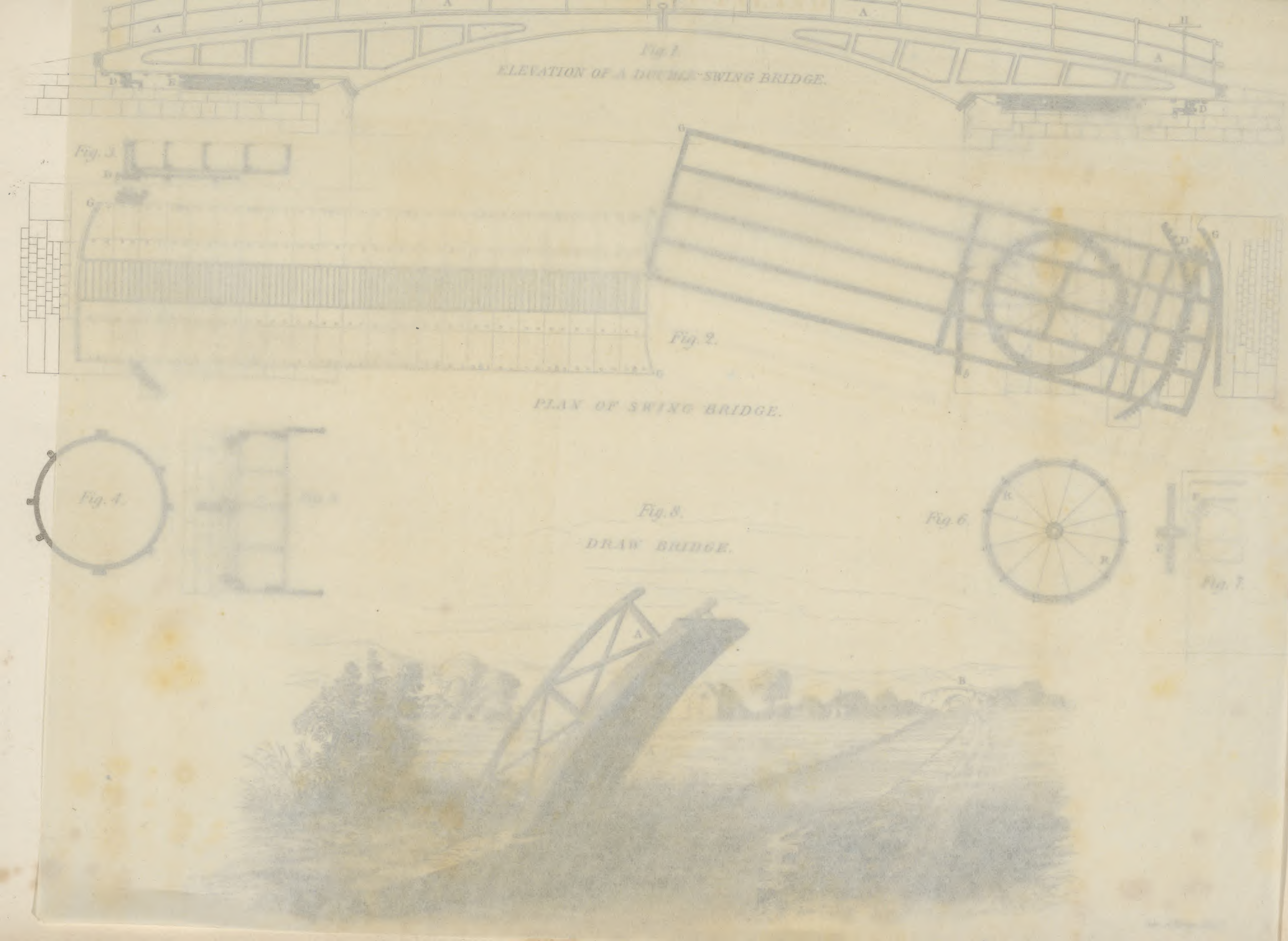

Fig. 1. ELEVATION OF A DOUBLE SWING BRIDGE.

Fig. 2. PLAN OF SWING BRIDGE.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8. DRAW BRIDGE.

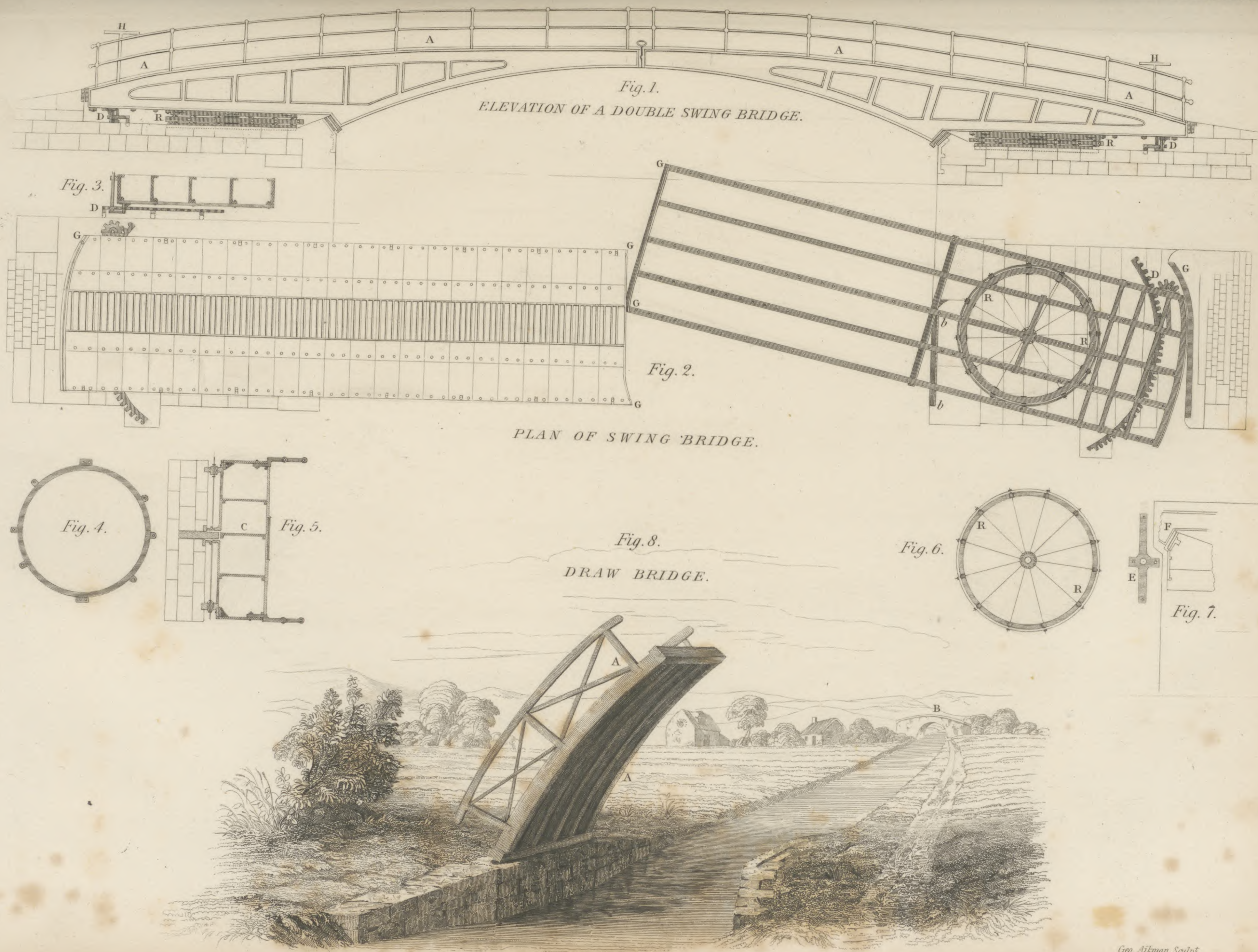

Fig. 1.
ELEVATION OF A DOUBLE SWING BRIDGE.

Fig. 2.
PLAN OF SWING BRIDGE.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.
DRAW BRIDGE.

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NETHERLANDS
now divided into
HOLLAND AND BELGIUM
English Miles.
5 10 20 30 40
NORTH SEA
ZUIDER ZEE
FRIESLAND
GRONINGEN
DRENTHE
OVERYSSEL
GELDERLAND
UTRECHT
HANOVER
Borkum
Schiermonnik I.
Ameland
Ter Schelling
Vlieland
TEXEL
Helder
Wieringen
LEEUWARDEN
Harlingen
Franeker
Bolsword
Sneek
Dokkum
Appingadam
Emden
The Dollart
Winschoten
ASSEN
Steenwyk
Meppel
Koeverden
Zwarte Sluis
Hasselt
Kampen
ZWOLLE
Ommen
Hardenberg
Oldenzaal
Almelo
DEVENTER
Zutphen
Enschede
ARNHEIM
NYMEGEN
Doetinchem
Emmerich
Cleves
Wesel
Harderwick
Amersfoort
UTRECHT
AMSTERDAM
HAARLEM
LEYDEN
The HAGUE
ROTTERDAM
Gouda
Schoonhoven
Gorkum
Hook of Holland
Mouth of the Meuse
Brielle
Alkmaar
Hoorn
Enkhuizen
Medenblik
Edam
Monnikendam
Purmerend
Naarden
Muiden
Elburg
Hattem
Vollenhoven
Blokzyl
Kuinder
Lemmer
Stavoren
Hindelopen
Sloten
Wageningen
Rheenen
Tiel
Grave
Heusden
BOIS LE DUC
Geertruidenberg
Zevenbergen
Willemstad
Bocholt
Borken
Stadt Lohn
Ahaus
Vreden
Groenlo
Nienburg
Rees
Broad Sand
Long Sand
Waden

Edinburgh, Published by A. & C. Black.

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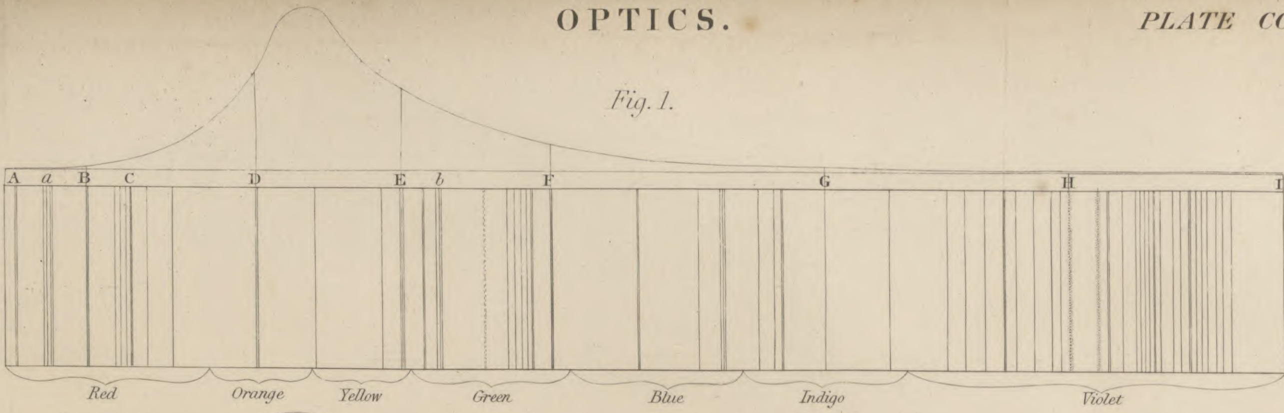
Fig. 1.



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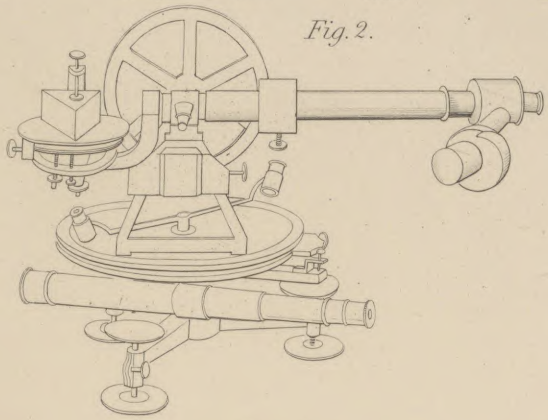

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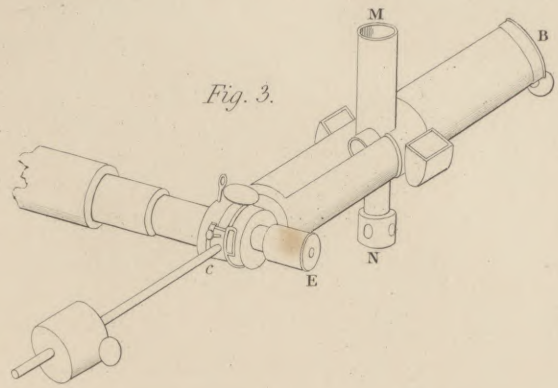

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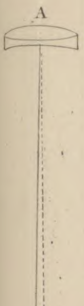
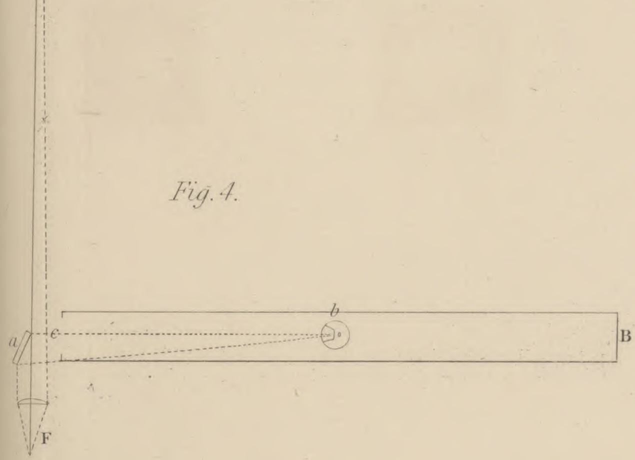

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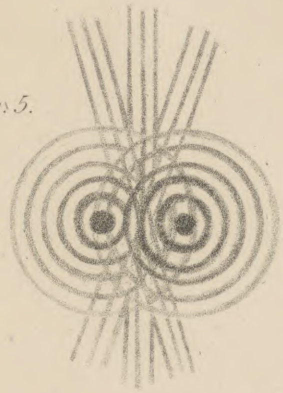
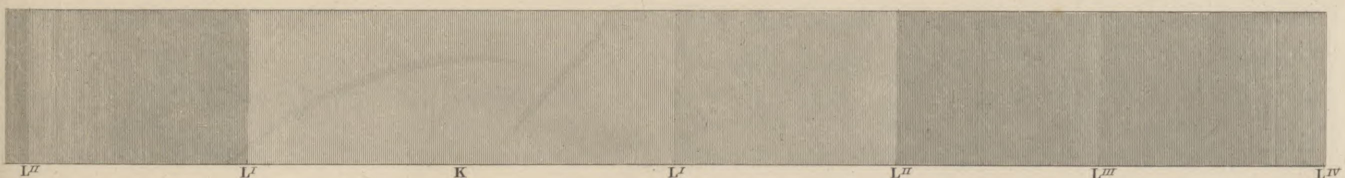


Fig. 6.

Fig. 7.



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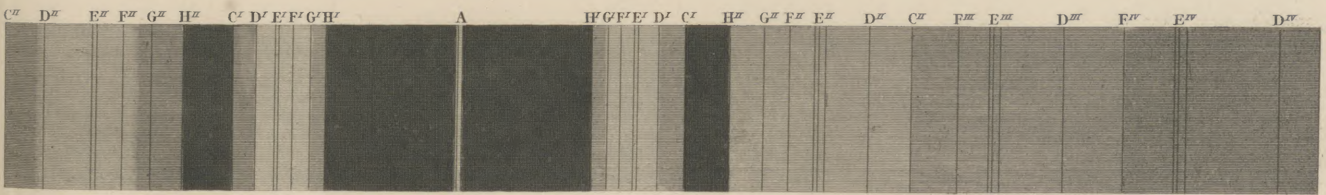

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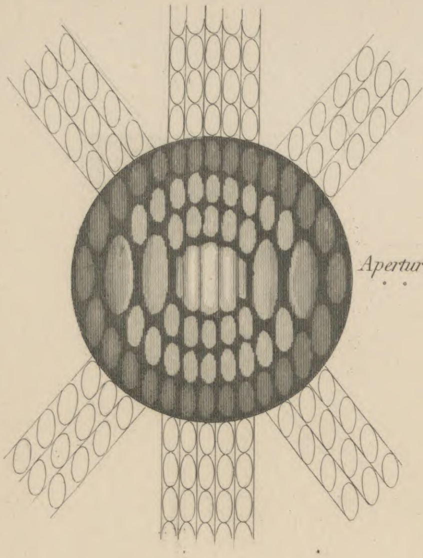
Fig. 9.



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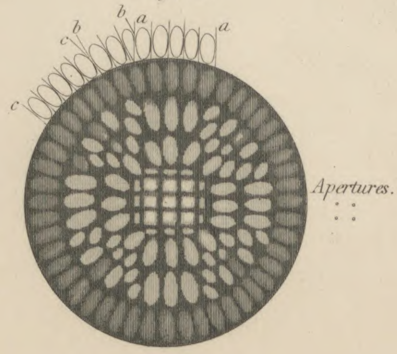

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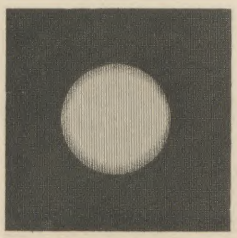
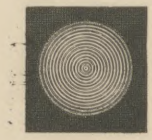


Fig. 12.

Fig. 13.

Fig. 14.



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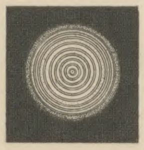

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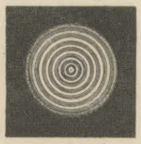

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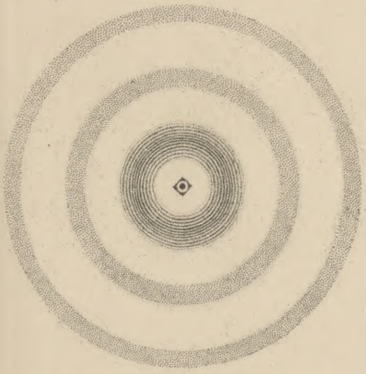

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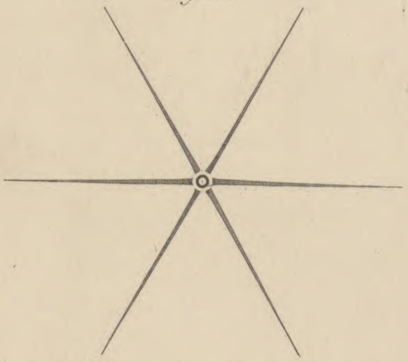

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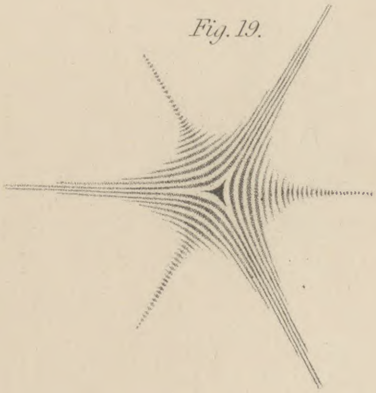

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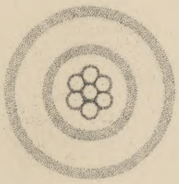

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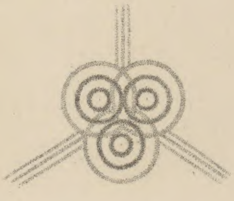

Fig. 22.

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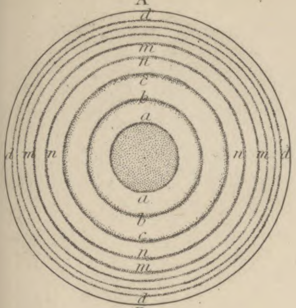

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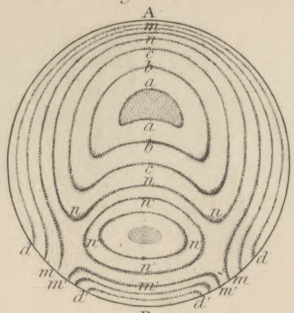

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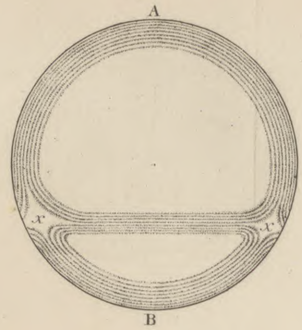

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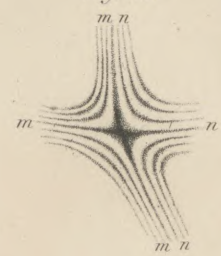

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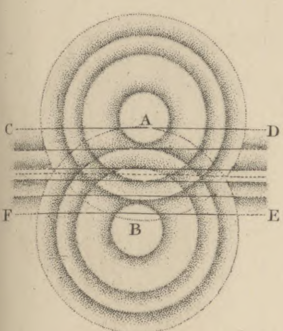

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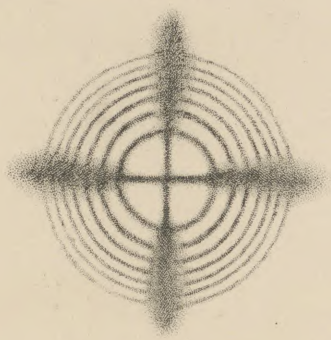
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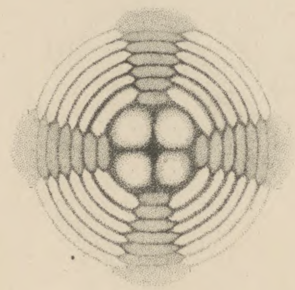
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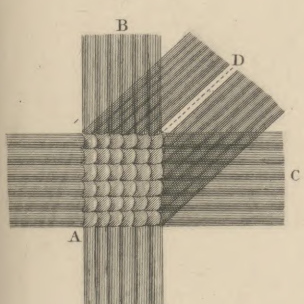

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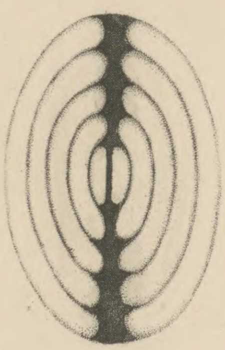
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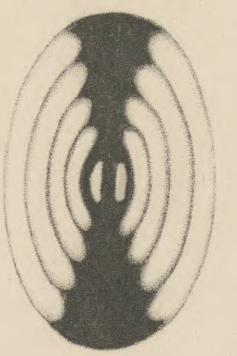
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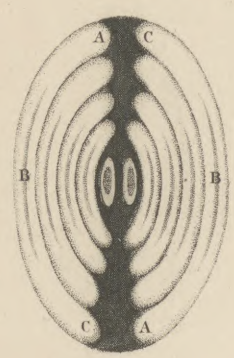

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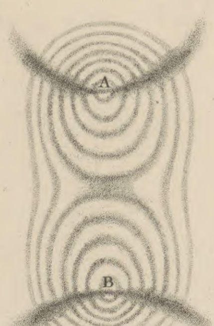

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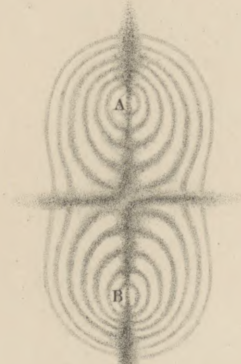

Fig. 37.

Fig. 38.

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Fig. 39.

Fig. 40.

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Fig. 42.

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Fig. 44.

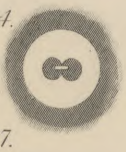
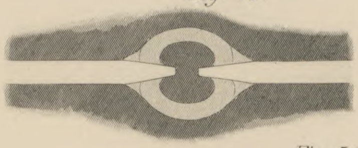


Fig. 45.

Fig. 46.

Fig. 47.

Fig. 48.



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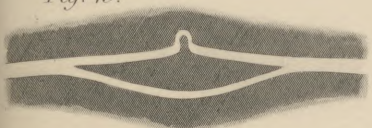

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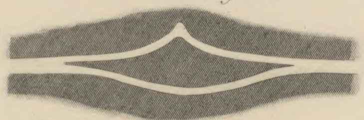

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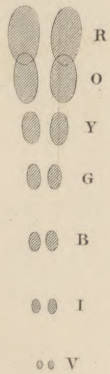
Fig. 52.



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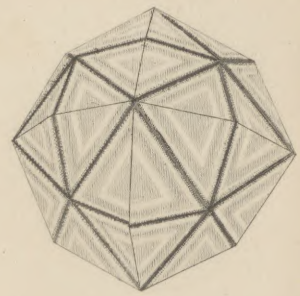

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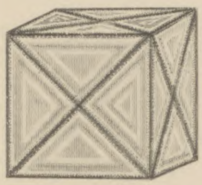

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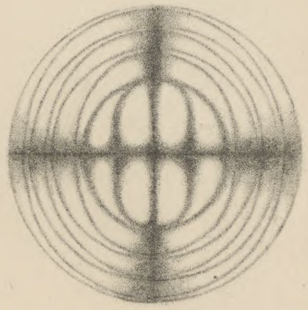

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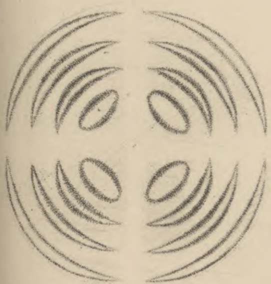

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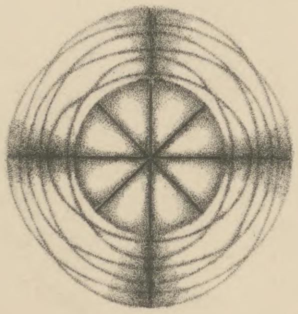

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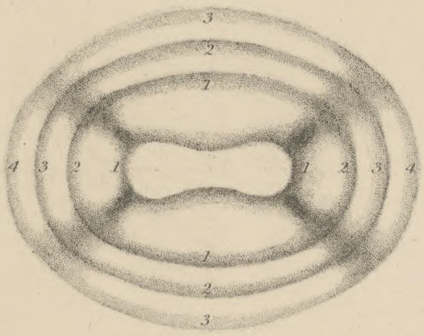

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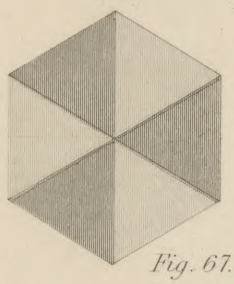

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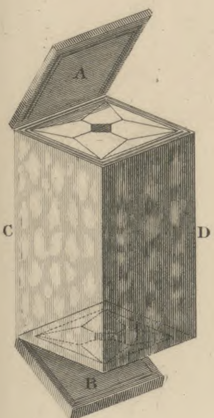

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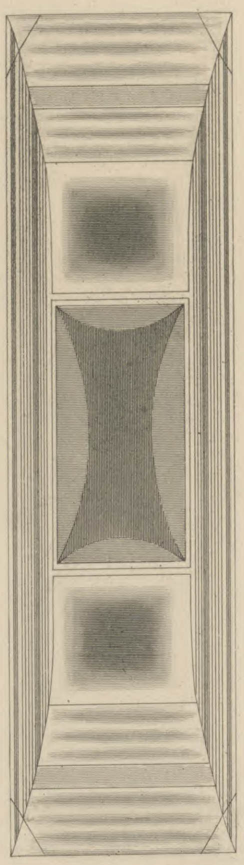

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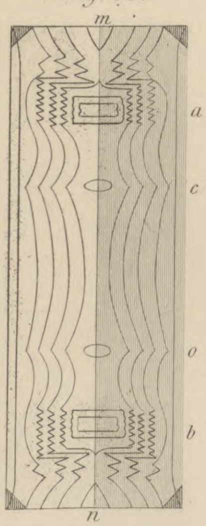

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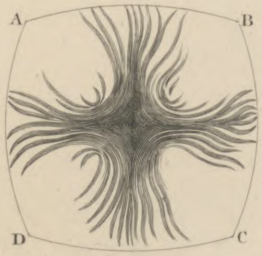

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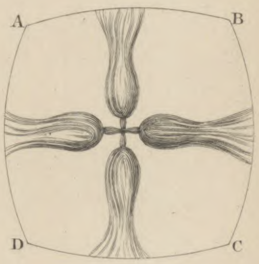

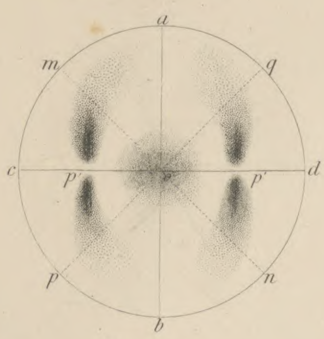

Fig. 67. twice.
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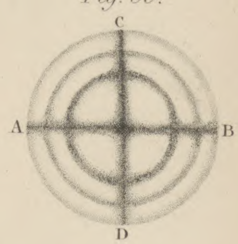
Fig. 69.



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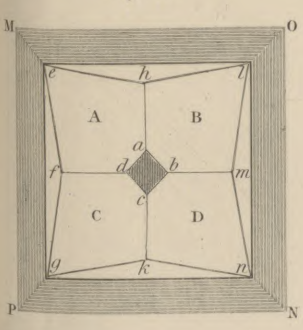

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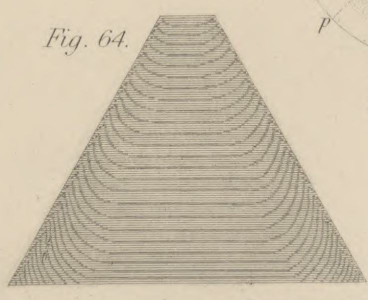
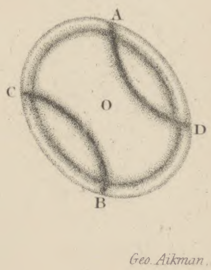


Fringes through the pyramid of Apophyllite

Fig. 70.



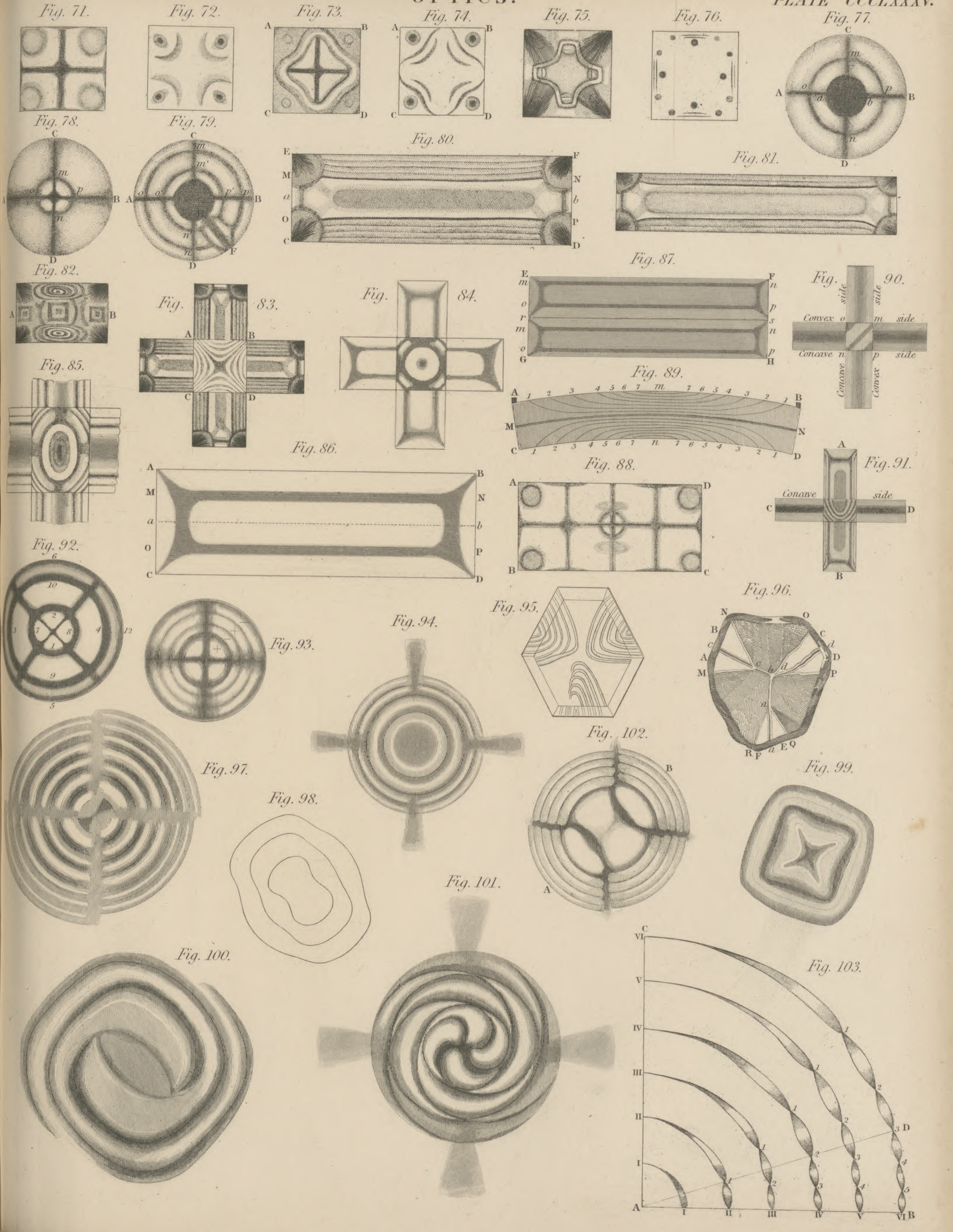


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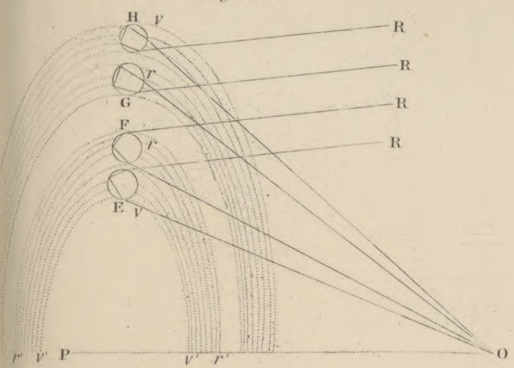
Fig. 104.



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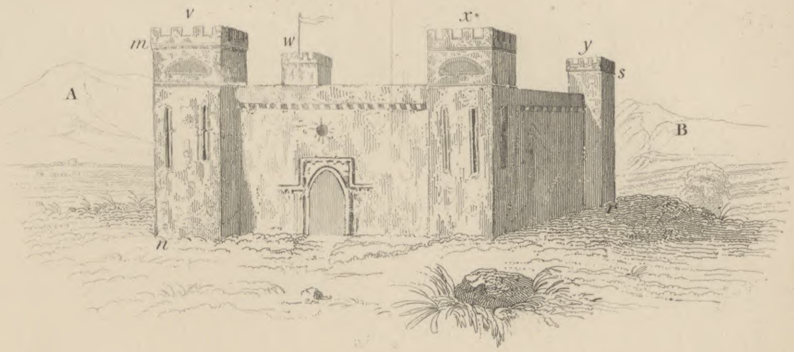

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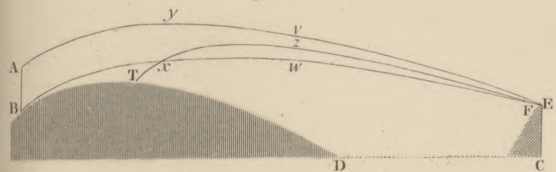


Fig. 107.

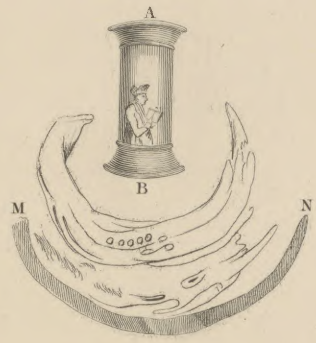


Fig. 108.

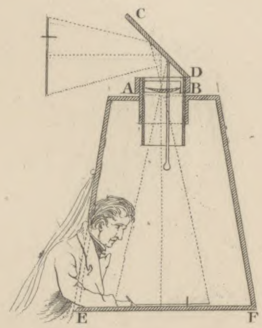
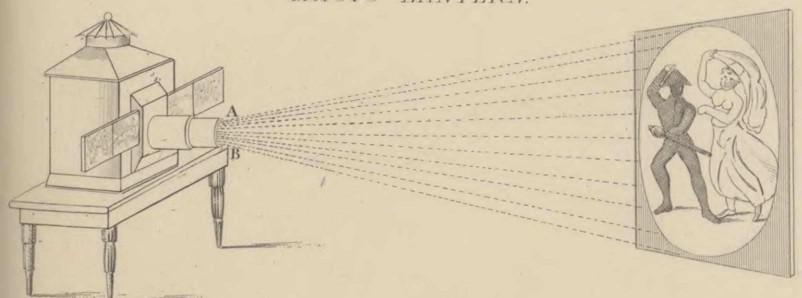


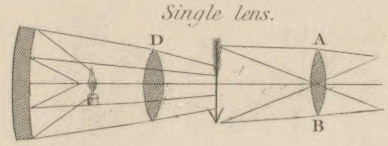
Fig. 109.

MAGIC LANTERN.

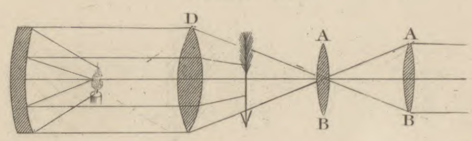


MAGIC LANTERN LENSES.

Single lens.



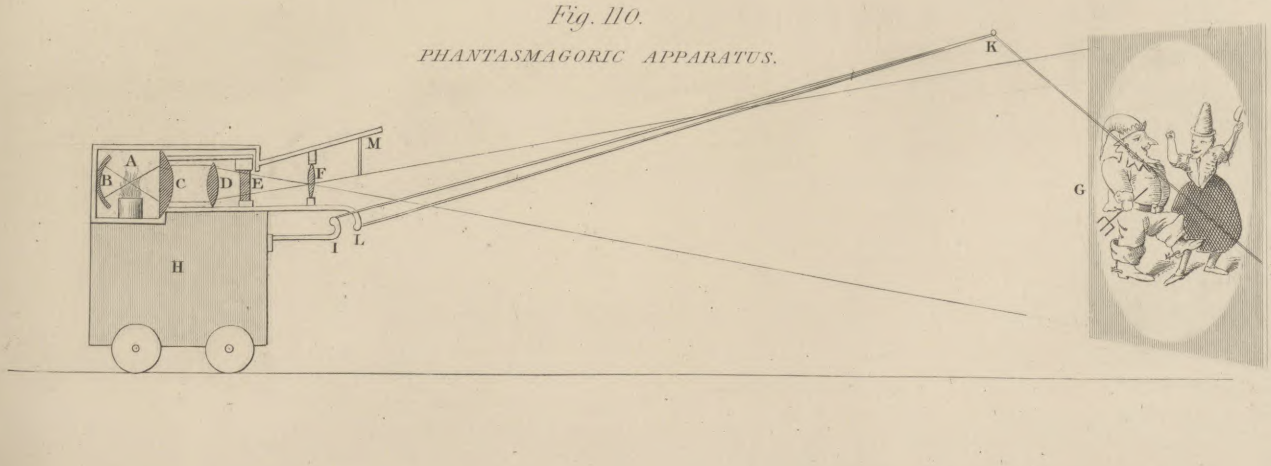
Double lens.



MAGIC LANTERN SLIDER.

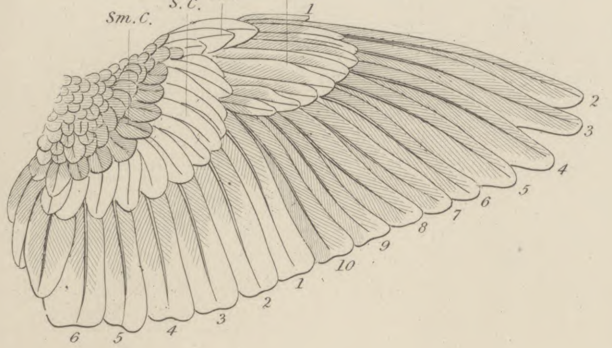
Fig. 110.

PHANTASMAGORIC APPARATUS.



Geo. Aikman. Sculpt.

1.



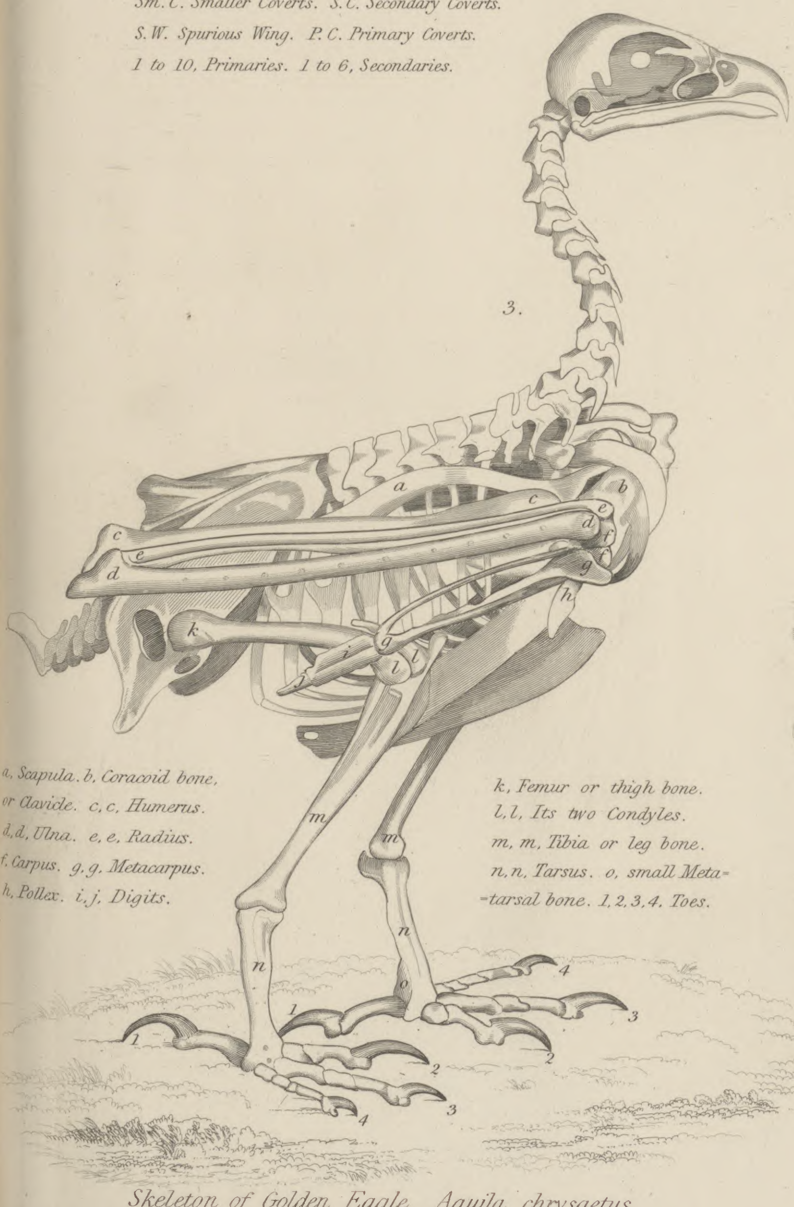
Wing of Starling _ Sturnus vulgaris.

Sm. C. Smaller Coverts. S. C. Secondary Coverts.
S. W. Spurious Wing. P. C. Primary Coverts.
1 to 10, Primaries. 1 to 6, Secondaries.

2.

Sc. Scapulars. Sm. C. Smaller Coverts.
S. W. Spurious Wing. S. C. Secondary Coverts.
P. C. Primary Coverts. P. Primaries.
S. Secondaries. T. Tertials.

3.

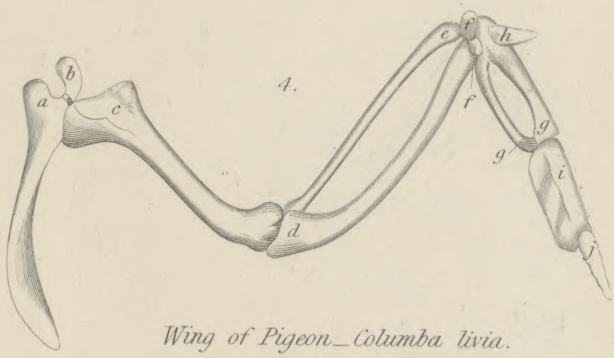


a, Scapula. b, Coracoid bone, or Clavicle. c, c, Humerus. d, d, Ulna. e, e, Radius. f, Carpus. g, g, Metacarpus. h, Pollex. i, j, Digits.

k, Femur or thigh bone. l, l, Its two Condyles. m, m, Tibia or leg bone. n, n, Tarsus. o, small Meta-tarsal bone. 1, 2, 3, 4. Toes.

Skeleton of Golden Eagle _ Aquila chrysaetus.

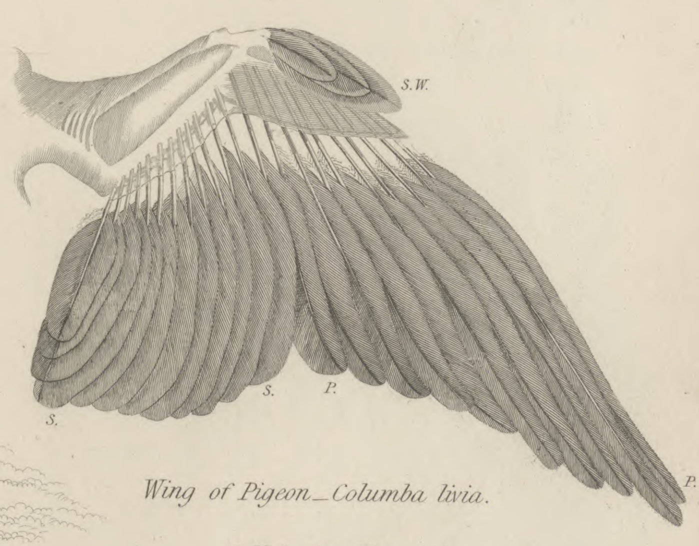
4.



Wing of Pigeon _ Columba livia.

a, Scapula. b, tip of Coracoid bone. c, Humerus. d, Ulna.
e, Radius. f, f, Carpus. g, g, Metacarpus. h, Pollex. i, j, Digits.

5.



Wing of Pigeon _ Columba livia.

S. W. Spurious Wing.
S. S. Secondaries.
P. P. Primaries.

...n by W. Macgillivray. *Geo. Aikman, Sculp.*


1.
Vultur cinereus.
2.
Cathartes aura.
3.
Sarcoramphus papa.
4.
Neophron percnopterus.
5.
Gypaetus barbatus.
6.
Caracara Braziliensis.
7.
Harpyia destructor.
8.
Haliaetus albicilla.
9.
Morphnus cristatus.
Geo. Aikman, Sculpt.

Geo. Aikman, Sculpt.


1.
Lanius collaris.
2.
Bethylus picatus.
3.
Beak of Vanga.
4.
Cephalopterus ornatus.
5.
Beak of Tyrannus.
6.
Beak of Chalybœus.
7.
Edolius remifer.
8.
Head of Gymnocephalus.
9.
Tangara chlorotica.
10.
Casmarhynchus variegatus.
Geo. Aikman, Sculpt.


1.
Myothera superciliosa.
2.
Ramphoceles Jacapa.
3.
Eulabes Javanus.
4.
Mænura lyra.
5.
Pipra pareola.
6. a.
Toe of Caprimulgus.
6.
Podargus Cuvieri.
7.
Calyptomena viridis.
8.
Corydon Temminckii.
Geo. Aikman Sculp.t

1. *Alauda cristata.*

2. *Colius leuconotus.*

3. *Foot of Colius.*

4. *Garrulus cristatus.*

5. *Cassicus cristatus.*

6. *Paradisea apoda.*

7. *Synallaxis Tupinieri.*

8. *Bill of Paradisea.*

9. *Bill of Dendrocolaptes procurvus.*

Geo. Aikman Sc.

Geo. Aikman, Sculpt.

Geo. Aikman, Sculpt

1.

Galbula ruficauda.

2.

Jacamerops grandis.

3.

Foot of Picoides.

4.

Coccyzus cristatus.

5.

Bill of Leptosomus.

6.

Indicator minor.

7.

Monasa leucops.

Geo. Aikman, Sculpt.

1.

Phœnicophæus superciliosus.

2.

Scythrops Novæ Hollandiæ.

3.

Pogonias major.

4.

Trogon viridis.

5.

Crotophaga ani.

6.

Ramphastos toco.

7.

Pteroglossus aracari.

Geo. Aikman Sculpt.

Macrocercus tricolor.

Calyptorhynchus Banksii.

Plyctolophus galeritus.

Pezophorus terrestris.

Head of Microglossum.

Microglossum aterrimum.

Corythaix Paulina.

Musophaga gigantea.

Geo. Aikman, Sculp.

1. Crax rubra.

2. Head of Ourax pauxi.

3. Gallus Bankiva, Male.

3, a. Gallus Bankiva, Female.

4. Tragopan Satyrus.

5. Cryptonyx coronatus.

6. Pterocles arenarius.

7. Ortyx Californica.

8. Tinamus rufescens.

9. Ortygis pugnax.

Geo. Aikman, Sculpt.

1.

Lophyrus coronatus.

2.

Casuarius galeatus.

3.

Vinago aromatica.

4.

Otis Arabs.

5.

Struthio camelus.

6.

Plumes of the Emeu.

7.

Psophia crepitans.

8.

Microdactylus cristatus.

9.

Anthropoides pavonina.

Geo. Aikman, Sculp.t


1.
2.
3.
Grus Americana.
Platalea ajaja.
Numenius longirostris.
5.
4.
6.
Machetes pugnax.
Rhynchæa capensis.
Recurvirostra Americana.
7.
8.
9.
Parra albinuca.
Chionis vaginalis.
Phœnicopterus Americanus.
Geo. Aikman, Sculpt.

1.

Podiceps cornutus.

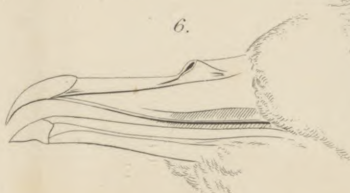
4.

Aptenodytes patagonica.

2.

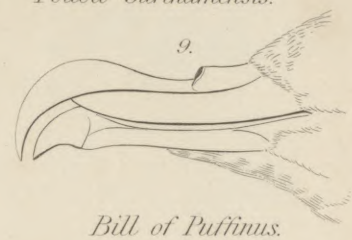
Podoa Surinamensis.

6.



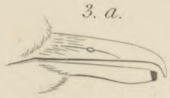
Bill of Pachyptila.

9.



Bill of Puffinus.

3. a.



Gen. Spheniscus.

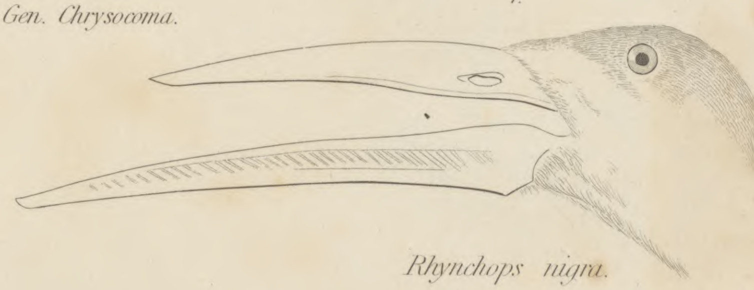
3. b.

Gen. Chrysocoma.

5.

Procellaria pelagica.

7.



Rhynchops nigra.

8.

Larus marinus.

10.

Pelecanus onocrotalus.

Geo. Aikman Sculpt.

1.

Plotus melanogaster.

2.

Cereopsis Novæ-Hollandiæ.

3.

Clangula histrionica.

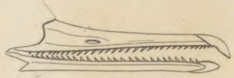
4.

Fuligula Valisnieri.

5.

Cygnus atratus.

6.



Bill of Mergus.

7.

Mergus cucullatus.

8.

Anas sponsa.

Geo. Aikman, Sculpt


PALESTINE
Scale of English Miles.
5 10 20 30 40 50
35
36
37
34
33
TRIPOLI Tripolis
Khan Bered Orthosia
El Kamkein
El Bakar
Menny
Medoowe
Akkar Raphanea
Belmont
Deir Natour
Callemon
Kifteen
Enfah Trieris
Ras el Shakaa
Eden
Batroun Botrys
Kanobin
Bshirrai
Amsheet
Aabeidat
Tanurin
Hosrun
Djebail Byblos
Laklouk
Afka Aphaka
Nahr Ibrahim Adonis R.
Alcobile El Bouar
Ghafar Jouni
Nahr Mahamitan
Annette
L.Liemoun
Deir el Akhmar
BAALBEC Heliopolis
Deir Aouan
Mtein
Zouk Mykayl
Nahr el Kelb Lycus R.
Tel Hezin
Rafka
Shaem
Nieha
Zahle
Abla
Antoun Elias
Dlebby
Mar Hanna
Beirout Berytus
Nahr el Salib or Beirout R.
Ras el Beirout
Hadded
Boorjee Khordlee
Deir el Kammar
Jee Porphyrium
Nebby Yunez
Platanon
Larouk
R. Awle
Saida Sidon
Mar Elias
Ruins Ad Nonum
Ain el Kantara
Nabathie
Abbosh
Sarfend Sarepta
Nsar
Arnoun
R. Abu el Aswad
Leontes
Khan
Hebron
Soor Tyrus
Ain Booboo
Cana
Ras el Ain Palæ Tyrus
Beitlot
Maron
Ras el Abiad or C. Blanco
Shimmah
Aiateh
Ain el Scanderoni Alexandroschene
Burge
Nakhora
Kafarletick
Tarshiha
Burge Msherify
Alma
Zib Achzib
El Mutshoor
St. Marys
Bay of Acre
ACRE Ptolemais
R. Naamany
Haypha
Mogar
Szaffad
Jordan
Jacobs Br.
Khan Djob Yousef
Tel Hoom Capernaum
Ain Tabegha Bethsaida
Tallanihie or Bethsaida
Bahr el Hoole L. Samachonitis
Yallahe
Kanneytra Canatha
Onhul
Kasem
Om el Mezabel
Nowa
Sharian
Keratha
Szanamein
Mehadje
Dsakeir
Redheimy
El Ledja
Ezra Zarava
Essammera
Bousser
Aahere
Ain Keratha
Doubba
Om Harereim
Heitt
Om Ezzeitoun
Shobba
Bezeine
El Khelkhele
El Hazzem
Essowara
Missema
Phænessus
Om el Kezour
Tebne
Dilly
Tseil
Wady Rokad
Shemskein
Hasbeya
Rasheia
Nimrod's Tomb
Bourkaish
Beit el Djanne or Ho. of Paradise
Sasa
Zaky
Tel Shakhab
Kareymbe Khan
Laish or Cæsarea
Jordanis Fons
Kanneytra
Ghabarib
Dify
Khan Denoun
Khiara
Soghba
El Merdjan
Aamoud Erzoubh
El Kessoue
Artous
El Sherafie
Bahr el Mardj
Nahr el Berde Abana R.
Katana
Dounnas
Salehie
Zebedani
DAMASCUS or Sham
El Ghouta
Rahle
Deneibe
Kor Aneh
Sultan Yacoub
Sonire
Medjdel
Nebi Abel Abila Lysaniæ
Sinie
Dummar
Eldjdile
Tel wy Menin
Kousair
Ktifa
Saydn yah Saana
R. Barrada Bardines
Zerdeni
Zurgaia
Djob Aadyn
Marra
Maloola
Eslarag
Yabrood Jabruda
Nebk
Deir Aatyah
Carah Carræ
Ain en Aalak
El Burge
Khan Seteel
Hassyah
Shemsyn
Shensher
Homs Emesa
Homs or Kadez L.
Katani
Gaseah
R. Aaszy Orontes
Dair Mousa
El Ras Orontis Fons
TRIPOLI
Libanus M.
Anti Libanus
Lebanon Mts.
Water of Lebanon
Rasheia
SEA
MEDITERRANEAN
DAMASCUS

Engraved by S. Hall, Bury Str.t Bloomsbury.

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